JAMES H. McGRAW, *Chairman of the Board*
MALCOLM MUIR, *President*
H. C. PARMELEE, *Editorial Director*
McGRAW-HILL PUBLISHING COMPANY, INC.

POWER

FRED R. LOW, *Editor*

IRVING FELLNER
Publishing Director

Volume 68 New York, December 11, 1928 *Number 24*

The Energy of the Sun

THE sun has apparently been radiating energy for billions of years in an amount equal to that produced by the combustion of some 50,000,000,000,000,000,000 tons of coal per hour.

All the conjectures as to the source of this energy that have been previously advanced imply a universe, or at least a solar system, initially full of life, motion, radiance and vitality running down to a dead level of temperature and ultimate death.

It seems more likely, more rational, more satisfying to think that this running down process is reversible; that somewhere in the mysterious processes of Nature there exists a phase in which the clock is rewound and the weight relifted.

And recent developments have indicated this as a probability and suggested a more plausible explanation of the source of the sun's energy.

The atom has been found to be divisible and capable of yielding prodigious quantities of energy by its disintegration.

Einstein has demonstrated that mass is not indestructible but may be converted into energy.

Jeans, Eddington and other noted astronomers assume that under the conditions of stupendous temperature and pressure existing in the interior of the sun and other stars, mass is being wholly converted into energy by the complete falling together of positive and negative electrons.

Millikan has discovered cosmic rays coming in from space which can be induced only by the building up of chemical elements out of the primordial positive and negative electrons.

This process can take place only under the conditions of extremely low pressure and temperature existing in interstellar space.

And so we have in the solar system a gigantic heat engine with a low-temperature level of absolute zero, one hundred per cent efficiency and a capacity due to an initial temperature of millions of degrees.

What becomes of this matter after it is recreated away off in the outer cold and darkness? Only by a miraculous precision in the balance of the forces acting upon it can it remain quiescent at the point of its birth.

The attractive power of the stars reaches out to infinity. Is it unreasonable to suppose that the newly formed matter, responding to the strongest of these attractions, begins its long journey to the nearest or most powerfully attractive star to contribute to the restoration of that portion of its mass that has been converted into radiant energy?

Is it not likely that there exists an equilibrium between the mass and attractive power of the sun and its capacity for converting matter into energy, and that it may be receiving its dissipated material back from space, not in a bombardment of gross meteorites, but in a tenuous stream of non-coherent atoms? That instead of slowly stoking itself to death, it is the focus or hot point of a stable cycle, functioning as it was in the beginning, is now and ever shall be: world without end.

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**

The Power Show in Retrospect

THE Seventh National Exposition of Power Mechanical Engineering will be drawing to a close as early copies of this issue find their way to the Show. Saturday has not arrived at this writing, but the steadily mounting attendance during the week points to the inevitable climax of attendance and interest on the last day.

What is the verdict of those attending? Some disappointment has been voiced at the absence of certain exhibitors seen year after year in the past. It cannot be denied that the gap thus created has been noticed by regular attendants at former Power Shows. But the fact remains that this has been an immense show in the number of exhibitors, in attendance, in the variety of equipment shown and the opportunities for self-education. Here thousands of eyes and ears have absorbed bits of information that will enrich industry by cutting power costs and improving the quality of power services. Manufacturers have formed closer ties with actual and prospective customers. Perhaps most important of all has been the fraternizing of engineers in a working atmosphere and the constant flow and counterflow of ideas from man to man.

No engineer who has a stake in efficient power production and utilization can attend such an exposition without increasing his grasp on his job and adding something vital to the creative imagination which must lie back of it.

An Investment; Not an Expense

IT IS common practice for individuals to borrow from their banks at five or six per cent and place the money in sound investments that return from seven to eight per cent and thus reap a handsome profit out of the difference. Similarly, a large proportion of our merchants carry on the bulk of their business with borrowed money, making their profit out of the difference between the net return on their goods and what they have to pay for the use of the money.

Why is it then that so many balk when it comes to the financing of new power equipment that offers large potential savings? The details may be different, but the principle is the same, and any one of several financing plans may be chosen to suit the conditions. One well-known consulting engineer recently remarked that he found it difficult to convince managements even when there was definite assurance of the investment paying for itself in from two to three years.

Perhaps it is because managements have become accustomed to look upon the industrial power plant as an expense rather than an investment. Or the present unparalleled prosperity may have something to do with the situation. At such times executives are not faced with the necessity of running down wastes. But isn't this just the time to invest in equipment which will effect operating economies that may change red ink into black during any lean years that follow?

Operating Methods That Save Money

GOOD operating methods pay large dividends in any plant, but a plant must be properly designed if the lowest production costs are to be obtained. A poorly designed plant, if well operated, will obtain better results than one of a good design that is neglected. This, however, is no argument in favor of poor design, since such a plant, like improper operation, is a liability in any undertaking, while economical design and intelligent operation are always an asset.

In the design of a power house the drives of the auxiliaries may materially affect the economy of the plant. The old idea, that it did not make much difference how inefficient the steam drives on the auxiliaries were, as long as all the exhaust was used in the feed-water heater, has long since been exploded. Where all the exhaust from both main and auxiliary units is absorbed by the heating system throughout the year, the efficiency of the auxiliaries is, it is true, a minor consideration. If, however, there is an excess of exhaust steam or the plant is operated condensing, then the auxiliary drives materially influence the efficiency of the plant by affecting the amount of heat that is thrown away in the exhaust to the atmosphere or in the condensing water. The highest efficiency is obtained when all the power is produced on the main units and the auxiliaries are motor-driven.

The mere selection of motor drive is not enough, however. Consideration must be given to the type of motor. In plants generating alternating current, motors of the induction type, such as suggested in the article, "Motors and Control for Power-House Pumps," have been used almost to the exclusion of the synchronous type. The power factor of the power-house auxiliary-motor load is usually low. The use of synchronous motors on some of the larger drives, such as the circulating pumps, would improve this condition.

One of the chief objections to the synchronous motor, its tendency to drop out of step and stall if the voltage dropped, has been overcome. Motors can be obtained

that will start by connecting them directly to the line and will start more than full load and pull it into step. In case of a voltage drop that would cause them to fall out of step, they will operate as induction motors until normal conditions are restored and then pull back into synchronism. Such motors will do practically all that induction motors will and in addition operate at a high power factor. These motors have been used for auxiliary drives with satisfactory results, allowing a reduction in the generator capacity to supply the auxiliary load, improving operation and decreasing the unit production cost.

Broader and Better Engineers

EVERY engineer must be a specialist to some extent, but the man who meets the famous definition of a specialist by "knowing more and more about less and less" is no longer the object of universal veneration. Engineering cannot free itself from human relations, from business, or any great element of our national life. If the engineer cannot fit his work into the economic and social fabric of his times, it ceases to have any significance except as a pastime or form of self-punishment, as the case may be.

It is a hopeful sign that engineers are turning from a mere tolerance of economics to a realization of the fact that business considerations are the core of every engineering problem.

In this evolution the A.S.M.E. is carrying its share of the responsibility. The Society has been criticized at times for the breadth of its coverage, yet the very diversity of interests represented insures a broad consideration of matters that come before it. This was particularly noticeable at the Annual Meeting just closed. No longer may the specialist wallow in his specialty without having to face the questions "How much will it cost?" "What will it save?" and "Why do it?"

The Great International Language

WE ARE entering today upon the great period of the international pooling of scientific knowledge. While diplomats and business men are still groping for a community of interest in the intricate and tangled affairs of world nations, our scientists and engineers are seeking out a meeting place whose territory is unencumbered by racial barriers. They are finding ground that is solid because it is governed by natural laws written in a single language intelligible to all—solid because science and engineering heed neither social distinctions nor the conflicting calls of alien bloods. A process that boils water in Alaska boils it also in India and in Paris. A German Diesel engine and an American generator will shoulder their responsibility side by side in Tokio or in Rio, careless of whom they serve, so only that he understand the laws of their operation. Like conditions produce identical results everywhere unless man himself enters to upset the equation.

In this truly universal language of the sciences lies the brightest hope of peace. A force that impels all peoples toward a common meeting ground is the only one that can level the barriers which they have built to protect their personal differences and over which they stumble constantly. Though nature may treat men cruelly, she does it with an impartiality beyond the reach of bribery. She presides over the only tribunal in which a lasting peace can be signed.

Because these things are so there are indeed great responsibilities resting upon the scientist and the engineer. How have these obligations been met? With admiration we can say that they are being carried on strong and active shoulders. This international sharing of technical knowledge received its great impetus from the lessons of the War and the World Engineering Congress in London in 1924 showed the principle so valuable that the period since has seen many other meetings of a general or special nature, while a program for further conferences is now planned three years ahead.

There is much ground to cover yet, much foundation building still to be done. But in our profession we hold the key to this new door to peace and prosperity. Ours is the obligation, ours the responsibility, ours the privilege. Shall any among us make the mistake of thinking that he is too far removed from the center of action to assume his share of that responsibility?

Refrigeration Research Needed

AT THE Annual Convention of the National Association of Practical Refrigerating Engineers the retiring president pointed out that while a greater number of people were using ice, the domestic refrigerating machine was making the lot of the ice manufacturer increasingly hard. It was predicted that from now on few new ice plants would be built, the activity being centered in the remodeling of existing plants.

This picture seems to be a portrayal of actual conditions, and the manufacturer of refrigerating machinery must find sleep somewhat uneasy. He must seek an outlet for his product, and if the ice plant fails him, sales must be found in other markets.

Many industries have found that the maintenance of a low temperature expedites their processing. For example, a slate-shingle maker discovered that the slate would cleave nicely in cold weather, but in summer would give a large percentage of poor shingles. He installed a refrigerating machine to give him the winter weather in July.

Other industrial managers have equally difficult problems and are not always possessed of so much imagination. It is up to the refrigerating machine manufacturers to examine industry and discover where their machinery would improve processes. They have an organization that could well make this research work part of its activities. With such research the ice-machine manufacturers could look into the future with more optimism than at present.

BOILER DRUMS

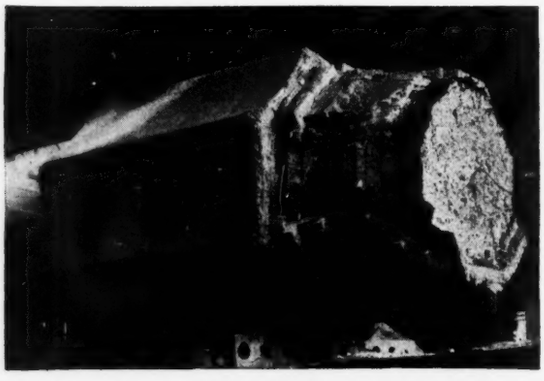
For the Largest 1,200-Lb. Power Plant

GO THROUGH THE SHOP

By John McQuillan
Stevens & Wood, Incorporated

THE introduction of higher steam pressures in modern power-plant practice has completely revolutionized the design and method of manufacture of steam-boiler drums, resulting in a product of the steel mill, the solid-forged seamless drum, that avoids the necessity of riveting and calking.

In 1923 the first steam drum of this type was designed for a working pressure of 1,200 lb. per sq.in. by Babcock & Wilcox Company, manufactured by the Midvale



This huge ingot will eventually take the form of a seamless boiler drum fifty feet long

company at Philadelphia and installed in the Edgar Station of the Edison Electric Illuminating Company of Boston. To date there are six installations using forged seamless boiler drums in operation, with working pressures ranging from 1,200 to 1,400 lb. per sq.in.

The largest 1,200-lb. pressure power plant in the world is now under construction at Deepwater, N. J., opposite Wilmington. This plant, designed and constructed by Stevens & Wood, Incorporated, of New York, for the American Gas & Electric Company and the United Gas Improvement Company, will have an ultimate capacity of 400,000 kw. The initial installation of two units will be approximately 120,000 kw. and will have four B. & W. primary boilers and two B. & W. reheater boilers, each boiler having an effective heating surface of 9,078 sq.ft. and a capacity of 330,000 lb. of steam per hour. The entire boiler equipment is designed for a working pressure of 1,400 lb. in the steam drum.

Manufactured by the Midvale Company at Philadelphia, the six boiler drums are 50 ft. 3 in. long, by 52 in. inside diameter and 60 in. outside diameter, made of open-hearth steel to the following specifications: Tensile strength, 75,000 lb. per sq.in. maximum; yield point, one-half tensile strength; elongation in 2 in., minimum, 24 per cent; reduction in area, minimum, 38 per cent.

Test specimen to stand cold bending through 180 deg. around a pin 1 in. in diameter without cracking on outside of bent portion.

The analysis of the steel follows: Carbon, maximum, 0.45 per cent; manganese, 0.30 to 0.45 per cent; phosphorous, maximum, 0.04 per cent; sulphur, maximum, 0.04 per cent.

The evolution of the steel ingot through the various pressing operations to the rough forging ready for boring and turning, and the subsequent closing-in of the ends is an impressive example of the progress of the art of forging.

The ingot is heated in a furnace having a truck-type bottom which moves out on rails, thus facilitating the transfer of the forging by electric crane to the hydraulic press. During the pressing operations the drum is rotated as required by means of a steel link belt suspended from a crane runway, the rotary motion being transmitted through a worm and gear.

The actual pressing operations are regulated by control valves, one man operating the valves for the application of the pressure and another man operating the valves that raise the ram. Hydraulic rams on both sides

After heating to forging temperature the ends of the ingot are cropped off in a 10,000-ton hydraulic press

of the press and operated by a third man move the forging as required and insert or remove the mandrel from the hole. The scale formed during the forging operation is removed from the bore of the drum by compressed air delivered by a tube held by a fourth man.

The entire operation is under the direction of the pressman, who conveys instructions to his helpers almost entirely by gestures.

From the pouring of the ingot until the forging is ready for turning and boring, covering a period of several weeks, the metal is never allowed to cool beyond the point where shrinkage cracks might develop.

After heating to forging temperature the ends are cropped off under a 10,000-ton hydraulic press where all the subsequent forging operations are done. Then the ingot is upset and a hole with a diameter of approximately 26 in. is pierced by means of a punch under the hydraulic press.

How the Drum Is Forged

This is the beginning of a series of forging or pressing operations, some of which expand the hole to the required size while others shape and elongate the drum to the required dimensions. Before each operation the forging is reheated to forging temperature, each heat taking approximately six hours. The actual time it is practicable to work the metal under the press on one heat is about half an hour, so that the heating time is approximately twelve times that of the press working time.

The expansion of the pierced hole is accomplished by pressure of the press from the outside of the forging against a mandrel placed in the hole and supported at both ends. This process is repeated, using mandrels of increasing diameter until the requisite bore is attained.

The forging is shaped and elongated by successive roughing operations over an unsupported mandrel, the function of which is to retain the size and shape of the bore during the pressing operations on the outside of the forging between the ram block and the V block at the bottom of the press. The ends of the forging are finished to a larger outside diameter and with a heavier wall than the main body of the forging.

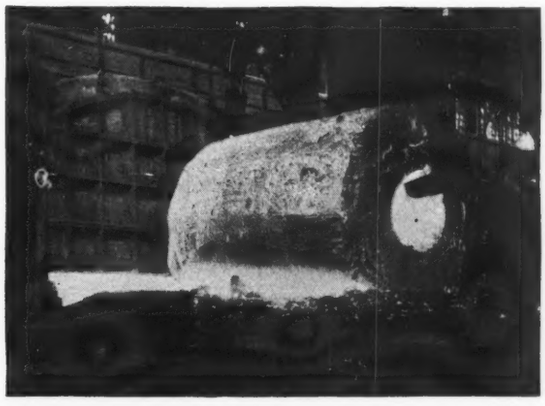
The forging is next annealed, after which test specimens are taken, one bend-test piece from one end, and tensile-test coupons from both ends.

Then the ingot is upset and pierced with a 26-in. punch under the hydraulic press

The test results being satisfactory, the forging is taken to a lathe for turning and boring, the outside diameter being turned to finished size simultaneously with the boring of the inside.

The boring bar has a star toolholder with four cutting tools 90 deg. apart, set so that four inches of metal may be removed as the boring bar advances, each tool taking a cut of approximately one inch.

The boring and turning proceeds continuously day and night over a period of about two and a half weeks,



The punched ingot is reheated to forging temperature. This reheating, which takes about six hours, is repeated before each forging operation

after which the drum is returned to the press shop for the closing-in of the ends. The manholes on the ends of the drum are of circular shape, the covers resting against machined seats on the inside of the drum ends. It is therefore essential that the manhole covers be placed inside the drum prior to the closing-in of the ends.

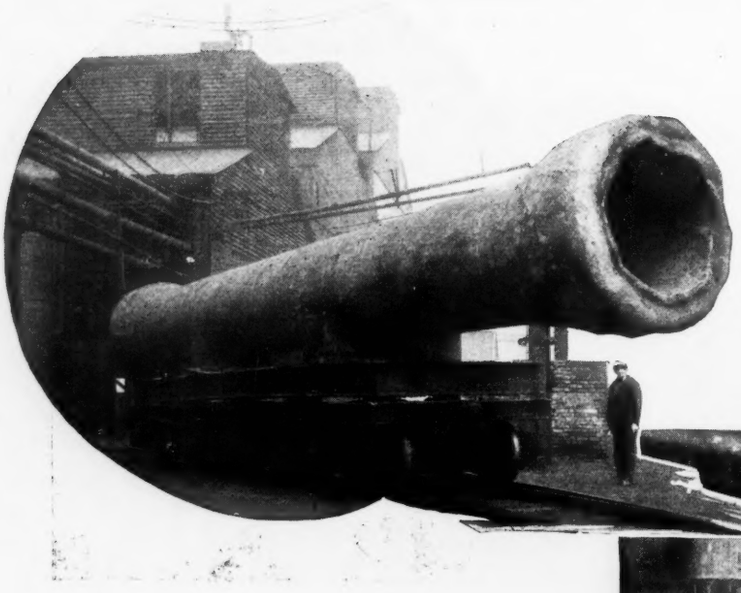
Finishing the Drum

The first heat on each end being the only two heats in the entire series of forging operations when the metal is raised from cold to forging temperature, the heating time is consequently much longer than any of the other heats, taking approximately eighteen hours. On the second heat the end is worked over a mandrel so that the closing-in will leave an opening to permit the entry of a boring bar for the end machining operation. The end just closed in is again placed in the furnace and allowed to cool off slowly to relieve forging strains. Both ends are similarly treated, after which the entire drum is simultaneously re-annealed.

The drum is then returned to the machine shop and placed in a lathe for the end-machining operation, which proceeds continuously day and night for a period of about two weeks.

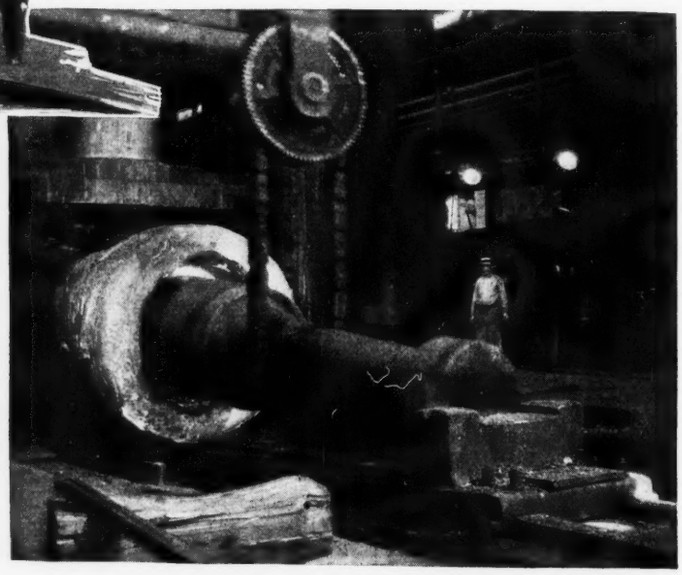
After drilling two holes, using the safety-valve locations, the drum is subjected to a hydrostatic test of 2,800 lb. per sq.in. Circumferential measurements were taken during the test of each of the six drums, which showed that at 2,800 lb. pressure the drum expanded circumferentially approximately three thirty-seconds of an inch and returned to a normal condition after the pressure was released to zero.

After completion of the hydrostatic test the drum, now weighing 65½ tons, is shipped to the boiler manufacturer for completion, which consists almost entirely of drilling the necessary holes for tubes, safety valves, etc., and mounting the accessories. There are virtually no manual operations in the fabrication of these drums from the pouring of the ingot to the mounting of the accessories on the finished drums.



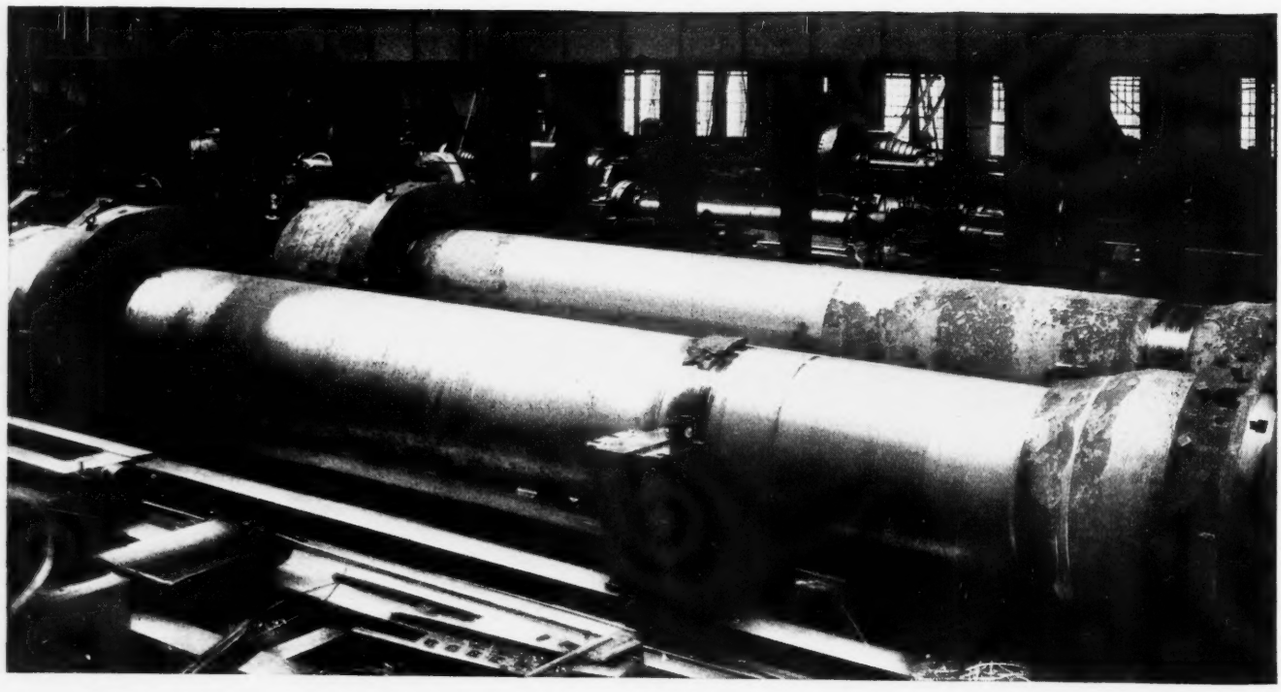
Below—Roughing the Ingot

This shows the forging process by means of which the ingot is brought to the form shown at left. The mandrel keeps the pierced ingot from collapsing when squeezed between the ram block and the V block at the bottom of the press.



Above—Drawn Ingot

The drum is ready for machining. The enlarged thickness at the ends furnishes material needed for closing the ends after turning and boring.

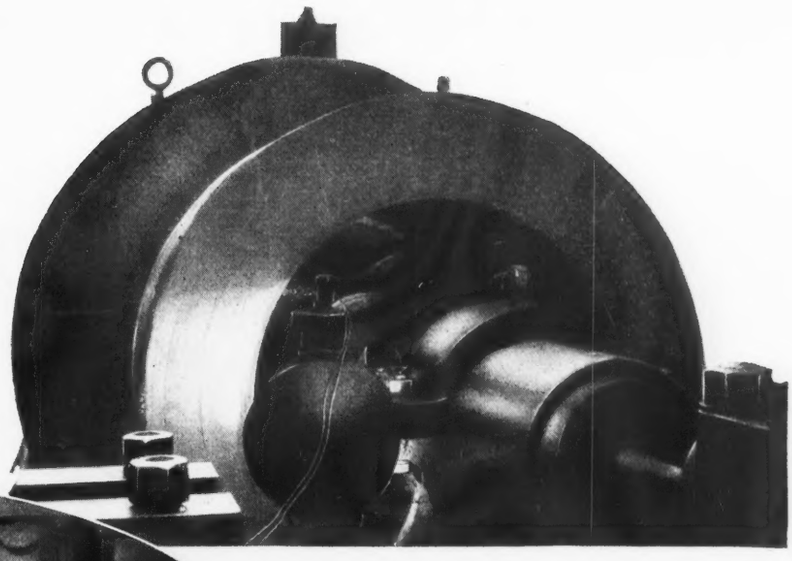


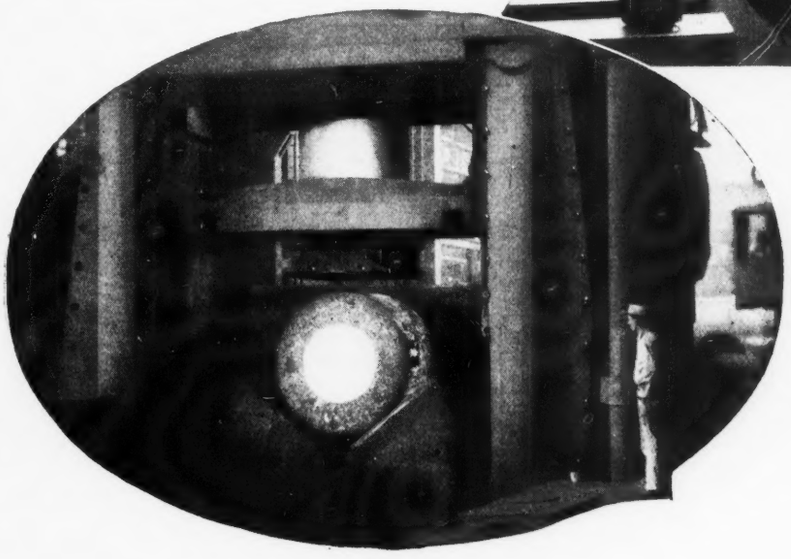
Boring and Turning

After annealing, the drawn forging is turned and bored simultaneously. The boring bar has a star tool holder with four cutting tools 90 deg. apart, each tool taking a cut one inch deep. This cutting proceeds night and day for about $2\frac{1}{2}$ weeks.

Below—Forging Ends in Press

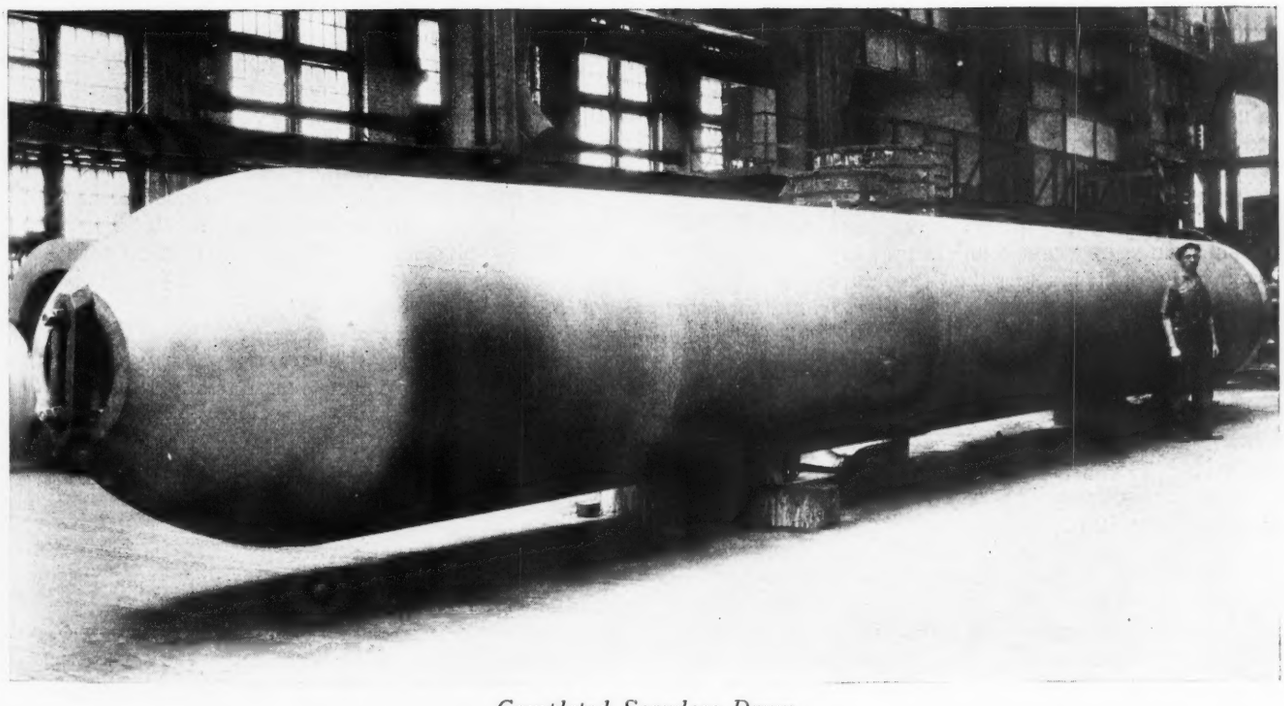
The ends are necked down in the press in two operations with heating before each. Manhole covers are placed inside the drum prior to the closing-in operation. The whole drum is annealed to relieve strains.





Above—Machining End

The ends are machined inside and out, the inside machined surface forming a seat for the manhole covers.



Completed Seamless Drum

After machining is complete the drum is given a hydrostatic test to 2,800 lb. per square inch, and is then ready to ship to the boiler manufacturer for drilling of tube holes and mounting of accessories. The completed drum weighs 65½ tons.

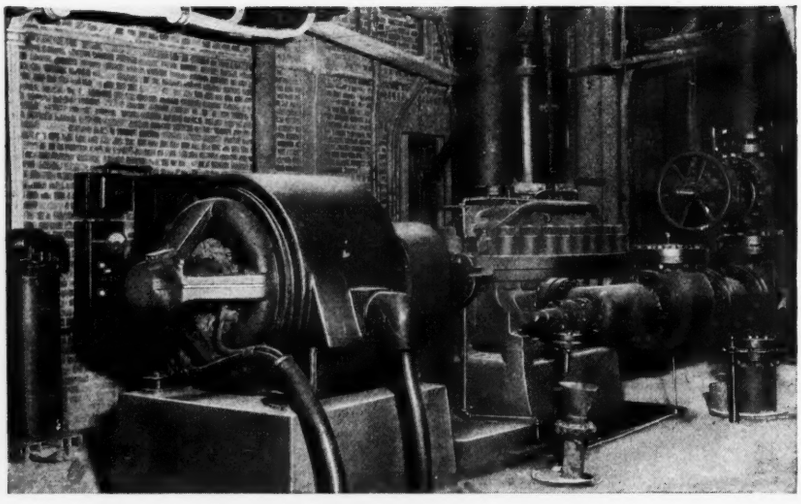


Fig. 1—Wound-rotor 600-hp. induction motor driving a boiler-feed pump

MOTORS AND CONTROL

for Power-House Pumps

By H. L. Smith

Industrial Engineering Department, General Electric Company

CIRCULATING pumps are included among the most essential auxiliaries in the power house. Their continuity of service is necessary for the operation of the main steam turbines. The relatively low cost of these pumps, as compared with the main unit, justifies either duplicate pumps or duplex motor-and-turbine drive on a single pump.

Constant-speed, two-speed or adjustable-speed motors are used for driving circulating pumps, depending upon conditions. When the turbine generator can always be operated at a comparatively high load, a constant-speed motor is sufficient. It may be desirable to vary the amount of water through the condensers according to seasonal changes in water temperature, as there would be a saving due to reducing the flow during the winter months. A two-speed motor will often be suitable for this condition.

Some plants have a number of variable conditions to contend with, such as variations in pumping head, water temperature, wide range in load on the main unit, etc. These require that the pump be operated at different speeds if a good over-all efficiency is to be obtained. The speed ranges required vary from 25 to 50 per cent reduction from full speed.

When speed regulation is required, the wound-rotor induction motor with secondary-resistance control is most commonly applied. For direct current, a shunt-wound motor with speed regulation by field control is used. For constant-speed or for two-speed applications, the squirrel-cage induction motor makes the simplest and cheapest drive.

These motors generally have good conditions under which to operate, allowing the use of standard open-type motors. Where the motors are exposed to dripping water, they should be provided with a drip cover unless they have a closed box-frame construction, which may be considered drip-proof. Fig. 4 shows a typical installation with an open-type motor.

Control for squirrel-cage induction motors will depend upon the voltage, capacity of the unit and interrupting capacity required in the primary switch. For motors started on full voltage at 2,200 volts, oil circuit breakers make the best arrangement. The oil circuit breaker should be automatic, either hand or remote controlled, with an instantaneous overload relay set high to give short-circuit protection. Undervoltage protection is not recommended.

For reduced-voltage starting, oil circuit breakers may be used for both starting and running switches, or a compact combination such as shown in Fig. 2 may be chosen, in which a time-delay undervoltage feature is included, preventing shutdown during momentary dips in voltage. The short-circuit interrupting capacity required is a deciding feature in the equipment that may be used.

On low voltage the interrupting capacity required is generally much smaller than at 2,200 volts and, especially for small industrial plants, allows the use of a simple air-break contactor, similar to that shown at the top of Fig. 3.

For wound-rotor induction motors the selection of a switch for the primary is determined by the same conditions as for the squirrel-cage motor.

The drum controller, either hand- or motor-operated with secondary resistance, is the most common device

for speed control. When the undervoltage release is omitted from the primary switch and the drum controller does not automatically return to the low-speed position, an additional section of resistance with a short-circuiting contactor should be used. This contactor is controlled by a time or current relay and is to insure restarting of the equipment after voltage failure, even with the controller left in a high-speed position.

Magnetic secondary control is more expensive than a drum controller and is seldom used except for large motors with high secondary current.

Fig. 3 shows a compact control arrangement for a wound-rotor motor in which a motor-operated drum controller, the secondary resistor and automatic-restarting equipment are all mounted as a unit. On the panel is mounted a push-button station for increasing and decreasing motor speed, as well as a start-stop station for remote control of the primary switch.

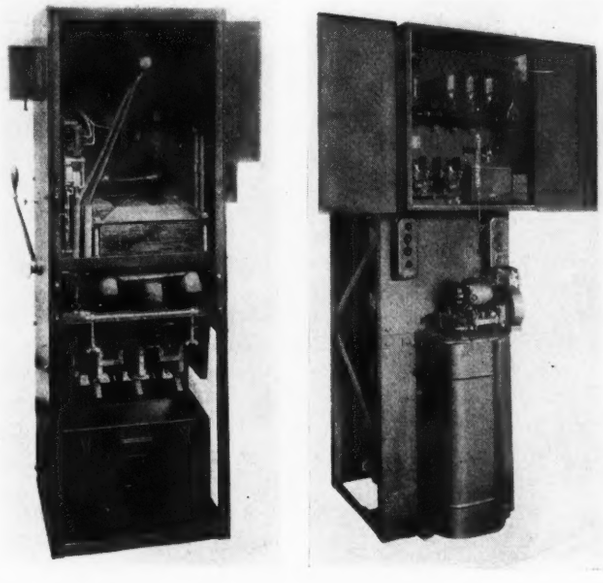
Air circuit breakers or contactors can be used in the line for direct-current motors. As on alternating current it is desirable to omit the undervoltage device and add a high setting on the overload. For starting these motors, a drum controller, preferably with points to cut out both armature resistance and field resistance in the same controller, makes a good arrangement. In case of complete voltage failure it is generally possible to bring all the motors up to speed by gradually increasing the voltage on the direct-current generator.

As in the case of circulating pumps, continuity of service with condensate or hotwell pumps is important and justifies their being installed in duplicate. Where they pump the condensate directly back to a surge tank, a constant-speed motor is all that is required and is an ideal application for a squirrel-cage induction motor started on full voltage.

Where they pump the condensate back through closed heaters, the head against which the pumps operate varies considerably with changes in the amount of condensate pumped. To secure satisfactory operation, it is desirable to have some speed regulation, using a wound-rotor induction motor or a direct-current motor with field regulation.

Figs. 2 and 3—Alternating-current motor controllers

Fig. 2—(Left)—Manually operated 2,200-volt squirrel-cage induction-motor starting compensator with dead-front steel cabinet and time-delay undervoltage trip. Fig. 3—(Right)—Secondary control for wound-rotor induction motor with automatic restarting equipment



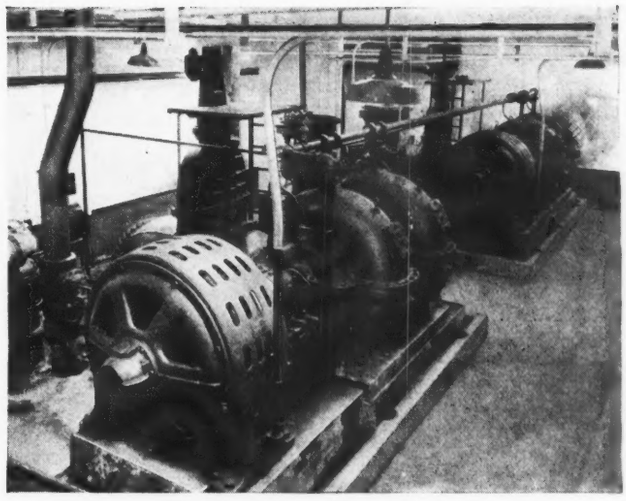


Fig. 4—Two 250-hp. squirrel-cage induction motors driving condenser circulating pumps

The same comments apply on the control as were made for the circulating pumps.

Continuity of service on a boiler-feed pump is probably more essential than on any other auxiliary. An interruption in the service of this pump introduces a hazard to life and property. It is common practice, therefore, to install one or more steam-driven units, in addition to the electrically driven pump. There should be some adjustment of the speed possible; a reduction of 20 per cent from full speed will usually be sufficient.

To regulate the water level in the boiler properly and reduce wear of the feed valves, the pressure drop across these valves should be regulated. One arrangement is to keep a constant differential across the valve, in which case the flow through the valve will be proportional to the valve opening. The other method is to use a variable differential so adjusted as to keep the valve opening approximately the same. The motor's speed is increased to increase the differential pressure across the valve and decreased to reduce the pressure.

Boiler-feed pumps are generally so located that standard open-type motors are suitable. For the large sizes at 1,200 and 1,800 r.p.m., an inclosed box frame gives a strong construction and comparatively quiet operation, as shown in Fig. 1.

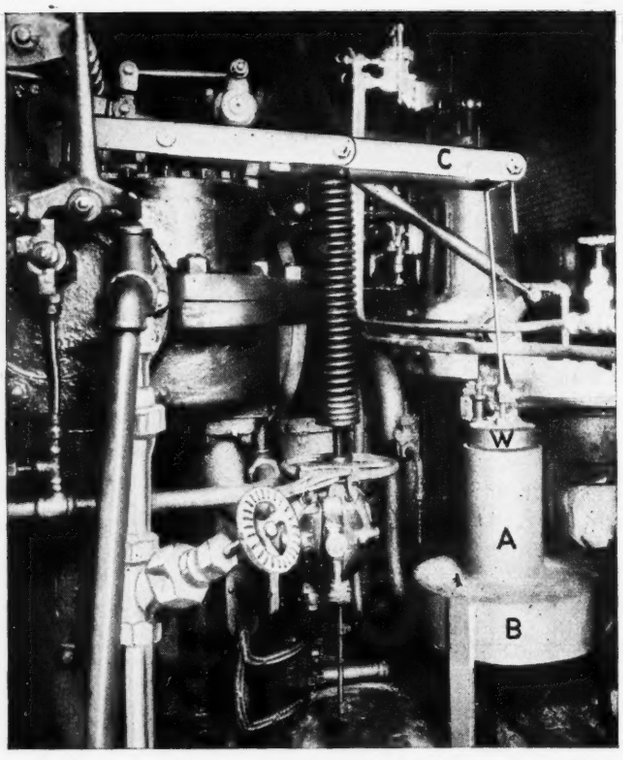
Primary control for the motors is determined by the same conditions as mentioned for the circulating pumps. On these units automatic regulating control of the motor speed is being used extensively, such as a pressure-regulator panel with a motor-operated regulator. This regulator operates a drum controller which is also equipped with a handwheel for manual operation if necessary.

The steam-jet air ejector is used to a large extent in removing the air from the condensers. When these ejectors are used, motor-driven vacuum pumps are unnecessary. The hydraulic-type vacuum pump is also largely used, generally steam driven, but when motorized, the squirrel-cage induction motor makes a suitable drive.

Slow-speed reciprocating vacuum pumps are used to some extent. The direct-connected synchronous motor is especially suitable for this drive. However, care must be exercised in applying synchronous motors to these pumps, especially the single-cylinder, double-acting type, because of the severe starting requirements which are sometimes necessary.

Automatic Heat Balance Regulation

By J. J. Hoerath
Chief Electrician,
Brunot Island Power Station Duquesne Light **Company**
Pittsburgh, Pa.



AT THE Colfax Power Station of the Duquesne Light Company, two 60,000-kw. three-element units are installed so as to operate independently. A house turbine, which exhausts into a closed heater, is provided to heat the boiler feed water for each unit. Station auxiliaries are supplied from either the house generator or the station transformer bus. An induction motor-driven generator or heat-balance set is connected between these two busses. This permits variation in load on the house turbine, as the heat-balance set will transmit power in either direction. An increase in the load of the house turbine causes an increase in the amount of steam passing to the closed heater and therefore a higher feed-water temperature.

> Governor designers generally use springs and links, and secure response to variable pressures through the medium of diaphragm-operated pilot valves controlling relay mechanisms. Here is a means for accomplishing somewhat the same end with greater simplicity.

Originally, the load on the house unit was regulated by the switchboard operator. A signal light was used to indicate when the exhaust pressure exceeded the desired upper or lower limits, and an atmospheric relief valve operated at a pressure of slightly over two pounds gage thus preventing excessive back pressure. Frequent regulation was required and it was practically impossible to maintain the boiler feed water temperature reasonably constant.

In order to overcome this difficulty, obtain close regulation and relieve the switchboard operator for other duties, an automatic load governor was devised. This regulator is an auxiliary device and operates independently of the regular turbine governor. It can be taken out of service at any time by unhooking the loading weight and does not interfere with the normal governor control. When it is in service, a variable load range is superposed on the fixed load control of the governor, the variation in load depending on the back pressure of the turbine.

This consists of an open chamber *A*, Fig. 1, connected to a closed chamber *B*, and a governor loading weight *W* floating on the mercury that occupies half the volume of the chambers. This loading weight *W* is attached to the governor arm. The closed mercury chamber *B* is connected to the exhaust of the turbine.

The photograph of this equipment as actually installed shows that the chamber *B* was built so as to encircle chamber *A*, making the device more compact and reducing the amount of mercury required. The weight *W* consists of a short piece of steel shafting and is hooked to the extended arm of the governor. This permits taking the regulator out of service, if it is so desired, by merely unhooking the weight.

The value and proportions of the weight *W* and length of the extension on the governor arm depend on the range of regulation required. This must be limited to a value such that the regular governor control can hold the load on the unit well below normal. Extreme load changes can be taken care of by the latter, and consequently an automatic range of 15 to 25 per cent of rated load is ample. For this range the governor spring will not require changing.

The operation of this regulator is as follows: Assume that a load exists on the turbine, which creates an exhaust pressure of one pound. An increase of feed water flow-

ing through the feed-water heater will cause the turbine exhaust pressure to decrease and the mercury level in the chamber *A* will drop. This causes the weight *W*, acting on the turbine governor arm, to increase the load on the turbine and thereby admit more steam to the feed-

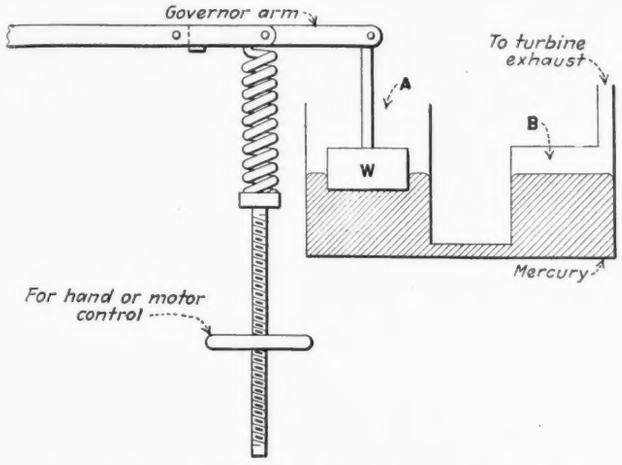


Fig. 1—The essential principle of the device is simple

Variations in pressure affect the mercury level and thus raise or lower the point of balance between the governor springs and the additional regulator weight.

water heater. This causes the exhaust pressure to rise and stops further movement of the weight *W*.

When the amount of feed-water through the heater decreases, the turbine exhaust pressure increases and the mercury in the chamber *A* rises. This reduces the load

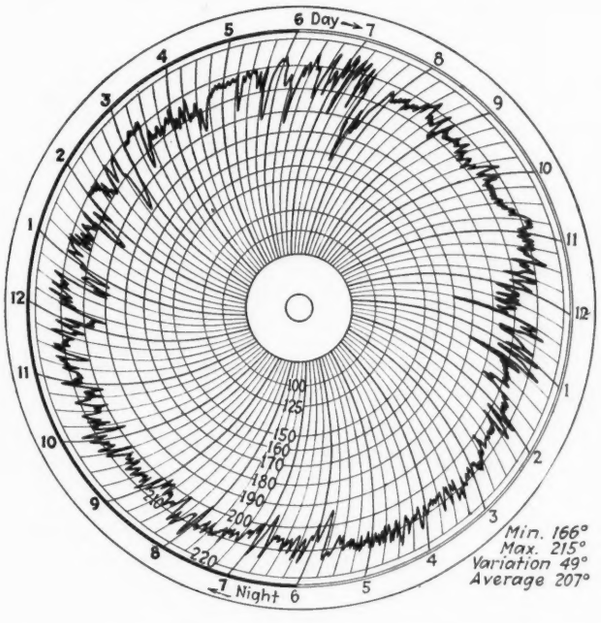


Fig. 3—An average chart with the automatic regulator in service

The maximum variation was reduced to 13 deg. F., and the average temperature was maintained at 215 deg. F.

on the turbine, decreases the exhaust pressure and prevents further rise of the weight *W*.

If both house turbines are in operation, the steam inlets to the feed-water heaters can be paralleled, thereby producing the same back pressure on both turbines. Satisfactory operation is obtained under this condition with either or both of the automatic load regulators in service. When one automatic load governor is used, the range of regulation will be only one-half as great as when both are used, and the back pressure may exceed the desired upper or lower limits. If this occurs, the light signal functions, and the switchboard operator varies the

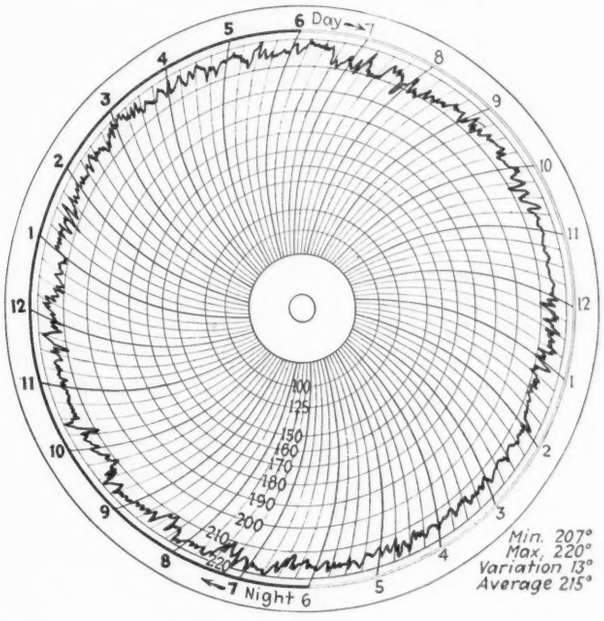


Fig. 2—Feed-water temperatures without the automatic regulator in service

A maximum variation of 49 deg. F. occurred, and the average temperature was maintained at 207 deg. F.

load on either or both turbines by means of the regular governor control.

LESS WASTE IN POWER APPLICATIONS

Contrary to general belief, there are few industries in which clutches cannot be economically used, and their general applications are increasing. In the next issue the leading article deals with the subject "When to Use Clutches in Power Applications." Clutches of both the mechanical and magnetic types are included and various applications suggested. An interesting application is where a clutch is used to replace the unloading valve on a compressor or the bypass on a pump, when synchronous motors are used. By this method the compressor or pump losses are saved during the periods when the machine is not required, and the synchronous motor is allowed to remain in service continuously for power-factor correction. An automatic pressure switch connects the motor to and disconnects it from the load automatically, through a magnetic clutch.

As a Plant Executive Sees

THE SAFETY PROBLEM

By MARIN PHILLIPS

Electrical Superintendent
International Paper Company
Niagara Falls, N. Y.

THERE has often been a question in my mind as to what benefit is obtained from posting safety bulletins in industrial plants, depicting the way accidents happened. Would not a photograph of an accident and an account of how it happened have more effect and stay in the workman's mind longer than a made-up bulletin?

How often have we heard workmen say, when commenting on safety bulletins, that they were only posed photographs and not actual happenings. I would suggest that safety bulletins be made up from photographs and descriptions of actual accidents wherever possible.

When it is attempted to tell some workmen that 110 volts of electricity is dangerous and that under the right conditions its shock may prove fatal, they are likely to pass it off by saying that they can eat 110 volts or that they have been shocked by it several times, or even a higher voltage, and got away safely. Perhaps a safety bulletin made up from the account of such an accident, as in Fig. 2, would be the best kind of warning. Bulletins of this character, I believe, would go farther toward eliminating accidents than those made with posed photographs.

The workmen should be encouraged to bring in photographs of accidents and clippings from magazines and newspapers for making up safety bulletins. I would also post bulletins on home accidents, such as gasoline and oil fires, explosions, blood poisoning due to neglect of cuts and scratches, burns, etc. This I would do to get the workman thinking safety at home. If a man is thinking safety at home, he is pretty sure to think it at work.

It is recommended that each department in the plant be provided with a small board on which to post these bulletins. Only bulletins of a general nature would be posted in every department in the plant. A bulletin covering a boiler explosion would be posted in the boiler house only, as the steam department men are the only ones interested in it or who have the power of prevention. An elevator accident would be posted where the operator and those using this equipment could see the results of unsafe condition or careless acts.

With such a system of safety bulletins in use, real head work and tact will be needed to add constructive advice in the space reserved for remarks. By a careful study of the account of the accident an excellent safety slogan can be added to each bulletin.

Industrial concerns are expending much effort and a lot of money to prevent accidents. But are our efforts in the right direction or are there other methods that will cost less, require less effort and get better results? It is my opinion that some different method of attack in safety campaigns is needed to eliminate accidents successfully. When men used to think of flying, they could see no other way to accomplish it than to have a device with flapping wings to imitate birds. Then it was discovered that the plane's wings did not need to flap in order to fly. Perhaps a safety genius will come along some day and show us that we are not working in the right direction to eliminate accidents successfully.

It is true that all accidents cannot be prevented, but it has been found that about nine out of ten are avoidable through proper guarding of dangerous places and co-operation of the workers.

In most plants too much of the safety gospel is left for the foreman to spread. This would be the ideal way if all foremen would consider it as much their duty to teach safety to their men as it is to do their work properly. There are always foremen in most plants that do not take an interest in safety work. Where such is the case and the safety teaching is

Safety bulletins should be made up from photographs and descriptions of actual accidents.

Each department should have have a bulletin board on which to post these bulletins.

Some method of attacking the safety problem other than those in use, might be more effective.

Spreading of the safety gospel is left too much to the foreman, even though he is one of the most important factors in getting the idea over to the workmen.

The management's big problem is to get the safety idea over to the individual worker.

The more the safety problem is studied the more evident it becomes that the prevention of accidents rests more with the workmen than anything the management can do by installing safeguards.

Workmen should be encouraged to make safety suggestions and report any unsafe working conditions.

left to them, there will be very little accident-prevention teaching done. I have paid particular attention to a foreman who has charge of a crew whose duty it is to move heavy machinery around the plant and do construction work. This crew is continually working against odds as far as safety is concerned. Rope blocks and chain falls have to be hung up, often placed near belts and other moving machinery, and heavy loads have to be skidded around on rollers, another common source of accidents.

In spite of the ever-present hazards, this foreman has fewer accidents than some others whose crews do not have to contend with the dangerous conditions. How does he do it? Simply by working and practicing safety. I have watched him start to pick up a board with an upturned nail in it or remove a truck handle

Cause of Accident:
A machine being loaded on to the car struck the car switch and started the elevator. The machine became wedged under the floor saddle and the hoisting cables were pulled out at the crosshead
Remedy:
When moving loads off and on elevators, be careful not to strike the car switch or hand rope. Where possible, open the safety switch

Fig. 1—Safety bulletin made with photograph of accident

out of someone's way, and one of his crew beat him to it.

I will wager that this foreman does less safety lecturing to his men than some of the others whose men have the most accidents. The foreman's actions will go farther in teaching safety methods than any lecturer can ever hope to do, if he is not practicing safety along with his lecture.

When a foreman allows a dangerous condition to exist in his department and does not correct it, he certainly cannot expect his men to practice safety. The only way to have a crew of men working safely, is for the foreman to be on the watch for unsafe conditions and make it a

TONAWANDA MAN FATALLY SHOCKED CONNECTING CORD

Tonawanda , July 16—Raymond Hartman, 32, of 379 Adams street was electrocuted tonight while attempting to connect an extension cord to an electric light socket in the basement of George Kopf's drug store, Adams and Kohler streets. The cellar had been flooded during the recent heavy rains and it is thought that Hartman's feet and hands were wet, causing a short circuit. A current of 110 volts passed through his body.

Hartman had been employed by the druggist doing some repair work in the cellar. Medical Examiner Charles E. Long of Erie County made an investigation, pronouncing the death due to an accident. Hartman is survived by his wife, a son nine years old, and a daughter agedtwo weeks; also his parents, Mr. and Mrs. Henry Hartman of Tonawanda.

This accident proves that low-voltage circuits are dangerous. Be careful not to touch the metal parts of lamps, sockets or switches

Fig. 2—Safety bulletin made with newspaper account of accident

point to correct them in such a way that the men will take notice.

In many plants weekly or monthly meetings are held to discuss and hear safety suggestions, and usually the foreman and superintendents are the only ones present except the mill manager and safety director. The management expects those present at the meeting to take what they hear and learn back to their men. Do they do it?

It All Comes Back to the Man

To make sure that the workmen get first-hand information of the safety meetings, discussions and suggestions, I would post a copy of the minutes relating to safety on the bulletin boards in the different departments throughout the plant.

How often do we see accidents happen that could have been prevented by some simple guard or precaution, and then the foreman or safety man does the necessary work to prevent the accident happening again. I have often wondered how many of these accidents could be prevented if the workman could be prevailed upon to tell his foreman or superintendent that such a condition is not safe.

A study of safety problems shows that elimination of accidents rests more with the workmen themselves than anything the management may do by building safety guards. The management's big problem is to get safety teaching to the men, and those best able to present this to the individual worker are the ones most successful in eliminating accidents.

Annual A.S.M.E. Meeting

Forty-Ninth New York Gathering Draws Attendance From All Parts of Country

HIGH-TIDE in the year's activities of the mechanical engineering profession was again reached during the first week in December, when the 1928 Annual Meeting of the American Society of Mechanical Engineers and the Seventh National Exposition of Power and Mechanical Engineering were held simultaneously. The meeting program covered a wide range of subjects with fewer than usual of interest to power engineers. There were, however, thirteen sessions of direct moment to the field, embodying a group of papers which are presented in abstract, together with the important discussion that was brought out, in the pages that follow.

As usual, steam engineering for both central stations and industrial power plants, occupied an important place in the program. Stress was laid on the broadening field that must be considered by the power engineer. It is no longer enough for him to be well-versed in what takes place within the power-house walls. He must now familiarize himself as well with the other activities of the industry with which his plant is connected, so that the power services he supplies may fit into the operations of that industry in the most economical manner.

That this necessity is well recognized was brought out in the progress report on steam-power engineering, made by the executive committee of the Power Division. This stated that steps are being taken to render possible a freer exchange of ideas among power engineers associated with the industries, and credited, in part, the present prosperity of the United States to such co-operation, which has resulted in abundant cheap industrial power.

Other phases of power engineering were not neglected, with two hydraulic sessions, and single sessions on oil and gas power, lubrication, fluid meters, refrigeration and power-plant material handling. The more technical phases of the field were dealt with in sessions devoted to fuels, steam-table research, power test codes, and boiler feed water.

During the week many committees and subcommittees met to report progress and frame plans for carrying forward the immense number of technical and engineering studies sponsored by the A.S.M.E. No less than 32 of these meetings concerned the power field; and such subjects as the boiler code, the power test code, care of boilers in service, oil and gas power, heat transfer, lubrication, smoke abatement, condenser tubes, power, fuels, effect of high temperature on metals, welding of pressure vessels, feed water, pressure piping, industrial power, meters and hydraulics were considered.

An ample social program was provided for the meeting. On Monday evening, December 3, came the annual business meeting of the Society at which the Junior Award was presented to Michael D. Aisenstein, Byron Jackson Pump Company, Berkeley, Calif.; the Charles T. Main award to Robert M. Meyer, Newark College of Engineering, Newark, N. J.; and the Student Award to Clarence C. Franck, Johns Hopkins University, Baltimore, Md. Immediately after, adjournment was had to other parts of the Engineering Societies Building for the annual "Open House," at which were provided entertainment and an opportunity for making friends.

The high point of the social events was the president's reception on Tuesday evening. There Alex Dow, the outgoing president of the Society, gave his presidential address, "Consistency a Jewel"; the incoming president, Elmer A. Sperry, was introduced to the Society, and honorary memberships were conferred on Mortimer E. Cooley and Ira N. Hollis. Following, the members and guests enjoyed an evening of dancing.

The annual banquet of the society, held on Wednesday evening at the Hotel Astor, was again the occasion for

C. E. GORTON
Vice-President

R. L. DAUGHERTY
Vice-President

WILLIAM ELMER
Vice-President

Reveals Broadening Fields

making new members welcome and bringing to their attention the service of the Society to them and their opportunity for increased professional service through the Society. Speakers at this dinner included President Alex Dow, President-elect Elmer A. Sperry, Past-President Charles M. Schwab and Dr. E. E. Free. The A.S.M.E. Medal was awarded to Julian Kennedy for services to the iron and steel industry.

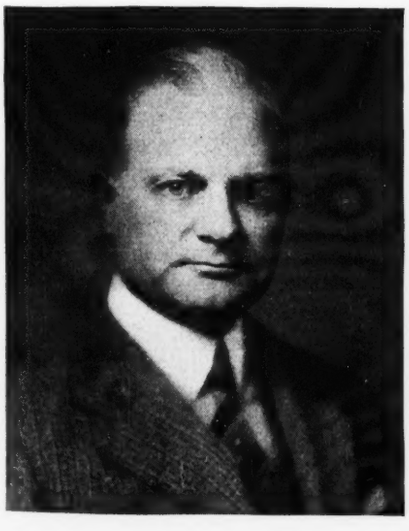
ELMER A. SPERRY
President

Excursions of unusual interest were enjoyed by many of those attending the meeting. Power plants visited included the Hell Gate Station of the United Electric Light & Power Company, and the Kearny Station of the Public Service Electric & Gas Company. At the former interest centered in the two 160,000-kw. units, one now being put into operation and the other almost completed. When this last unit is in operation, the station will have an installed capacity of 605,000 kw. At Kearny Station much attention was attracted to the three new boilers of 22,900 sq.ft. of heating surface each, in which full water-cooled walls are provided and almost no firebrick construction is used.

An inspection trip to the motorship "Kungsholm" gave an opportunity to investigate a passenger vessel of the highest type, equipped with Diesel engines. These motors are of the eight-cylinder, double-acting type and are capable of developing 24,000 hp. At the Brooklyn Navy Yard another type of marine power plant was seen when the new cruiser "Pensacola," with its 107,000-hp. steam power turbines, was visited.

Officers elected for the coming year were: For president, Elmer A. Sperry, chairman board of directors, Sperry Gyroscope Company, Brooklyn, N. Y.; vice-presidents, William Elmer, special engineer, Pennsylvania Railway Company, Philadelphia, Pa.; R. L. Daugherty, professor of mechanical and hydraulic engineering, California Institute of Technology; and C. E. Gorton, chairman, Uniform Boiler Law Society, New York City; managers, Charles M. Allen, professor of hydraulic engineering, Worcester Polytechnic Institute, Worcester, Mass.; Ely C. Hutchinson, president, Pelton Water Wheel Company, San Francisco, Calif.; Robert M. Gates, manager, industrial division, Superheater Company, New York City; delegates to American Engineering Council, E. A. Sperry, chairman; E. O. Eastwood, D. E. Foster, W. P. Hunt, O. P. Hood, Charles Penrose, F. A. Scott, Max Toltz, E. N. Trump and D. R. Yarnall.

ELY C. HUTCHINSON
Manager



ROBERT M. GATES
Manager

CHARLES M. ALLEN
Manager

Consistency a Jewel

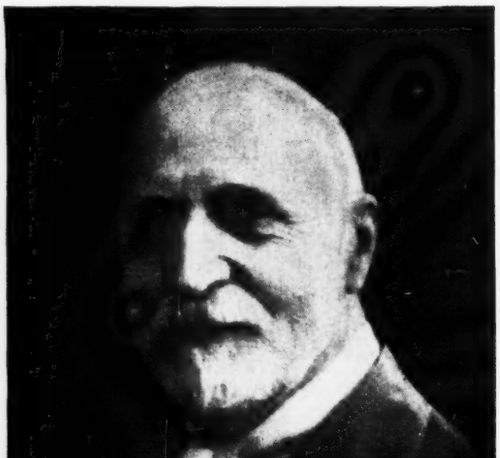
PRESIDENTIAL ADDRESS

TRADITION and precedent would have the retiring president deliver an address wise in content, literary in form and of the nature of a message to the membership. Owing to the peculiar perversity of the present moment retiring President Alex Dow said that he had but the semblance of a message to deliver from which certain grains of reality might be culled by the careful listener. No doubt he had the mixed audience in mind, for his talk was interspersed with humorous anecdotes and illustrations and, all in all, was most entertaining.

One of the things that had bothered Doctor Dow of late had been the over-use of certain good words. He had listened to talk of consistent statistics, of consistent policies, of consistent behavior, of consistent merit, until the word had become an irritant.

This impingement of an overfrequent word was no new experience. Many years ago when welfare (by implication welfare of employees as a duty of employers) had been much talked about, he had become hostile to the word. What had offended him was little—the overwork of a good word and the superfluity of talk about good work done. Other abused words were efficiency and research.

The word consistency had not as yet been classified by him as an irritant, and he was minded to help save it from misuse by limiting its application to the useful quality that it signifies by the dictionary definition. His talk of the evening was directed mainly toward the redemption of this good word from misuse and to the praise of this truly valuable quality.



ALEX DOW
Retiring President

Among several queries made to illustrate his point of view, Doctor Dow asked how far a Society like the A.S.M.E. could expand its assistance to meritorious projects. The aims of the Society were set forth with reasonable conciseness in the constitution and bylaws, and these aims were neither divergent nor inconsistent. Nevertheless, there was a constant call upon the Society to scatter its efforts, to turn the organization to other aims and objects than those on which the members were united by definition. If the Society was going to take up the work of the Church, state, or of the municipality, or any part thereof, it would be necessary to expand the statement of aims and the qualifications for membership until the Society was prepared to receive all men of good intent and to act upon any proposal whatever that tended to the betterment of mankind. That road led to disunity and disaster.

"Are our methods of educating engineers consistent?" was another query of the speaker. Here it would be discovered that the target was not a unity, but a diversity. In any engineering college two groups would be found who were receiving a standard prescription of schooling, notwithstanding divergent group purposes. One group, who individually had his hearty sympathy, were young men having a bent for engineering and who must educate themselves as quickly as possible to the point where their selected profession might begin to make them a living. The other group contained the men who were seeking knowledge for the love of it, the young men whose family or business prospects were of such a nature that an engineering education would be helpful in the furtherment of those prospects, and the few who intentionally sought engineering training as part of a liberal education.

Even if there were no other divergencies of aim, the adoption by most of the schools of a compromise formula for engineering education was inconsistent with the divergent aims of the students. To Doctor Dow the answer was separate schools. Let the student who must become a useful and productive junior member of the profession at the earliest possible moment, choose the school that would turn him out trained to the minute for an awaiting job. Let the other students go to a university where the broad principles of engineering were taught as an incident of the broader teaching of physics, or of natural philosophy. Thus only might each curriculum have the unity of aim that would make it consistent for the class of students involved.

Human need of consistency, Doctor Dow thought, was an evidence of superiority of mankind. If we were to be controlled by intellect, we must insist that each thing decided in our individual lives shall remain decided. Our seeking must be for accomplishment and not for talk about possible or past accomplishments. Our need was that, having done one thing, we shall go on in peace to the doing of the next. We do not desire repetition, but we insist that there shall be continuity by consistency in the rule of life.

Industrial and Central Station Power

Following former procedure, two sessions were devoted to power, one dealing with industrial problems and the other with subjects of primary concern to the central station. Topics considered were alloy steels for high temperatures, balancing heat and power, steam piping design, radiation in boiler furnaces, and peak load problems.

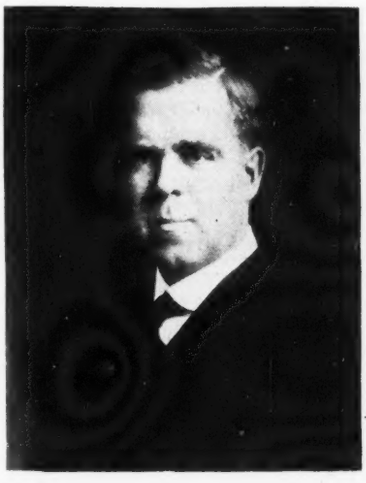
Progress reported by the Power Division revealed no striking new developments but rather consolidation of gains incident to past progress and intensive work in raising the average standard of steam station design and operation. Major objectives that had been attained were enumerated and, to lower costs, study of certain problems suggested.

Alloy Steels for High Temperatures

AT THE industrial power session a comprehensive and instructive paper on the stability of alloy steels was presented under the joint authorship of A. E. White, director, and C. L. Clark, assistant investigator, Department of Engineering Research, University of Michigan. The authors point to the fact that during the last few years alloy steels have made rapid strides in an entirely new field, namely, in the construction of metallic parts that are to withstand stresses at elevated temperatures. Owing to their relative cheapness and ease of fabrication, plain carbon steels had been used, but because of their recognized limitations their place was being taken in ever-increasing degree by alloy steels. The large number of alloy steels available created confusion as to just which one was best suited for the problem at hand, so it was considered that information would be welcome regarding the effects of the various alloying elements upon the steels to which they were added.

The authors have endeavored to throw additional light on, and to furnish further data with respect to, the properties of metals at elevated temperatures by, first, advancing a theory or hypothesis accounting for the stability of the various types of steels at elevated temperatures, and, second, giving specific data showing the effect of elevated temperatures on various steels when in an annealed or normalized state, and the effect of heat treatments that presumably would bring out the best possible proportional-limit values on various types of steels when tested at a temperature of 1,000 deg. F.

A. E. WHITE



Discussion of Professor White's paper called attention to the high qualities of the "austenitic" steels, such as those having 24 per cent nickel and 20 per cent chromium, or 23 per cent nickel and 17 per cent chromium. Long-time drawing tests on these alloys show not over one per cent creep in a year. These alloys also resist corrosion at high temperature. However, they do not have the physical properties at high-temperature of some other alloys.

Long-time drawing tests on 8 per cent tungsten, 8 per cent chromium alloy steel show the original Brinell hardness of 630 reduced only to 510 after 2,900 hours. With 17 per cent tungsten and 4 per cent chromium, 2,100 hours of test showed a hardness of 600 Brinell.

Large grain size is shown by test to be an advantage under high temperatures; for though it reduces the ductility, it increases the strength. This quality of grain-size is susceptible to a balance against ductility, and it was felt that a metal with 16 per cent elongation at 105,000 lb. per sq.in. stress was justified.

Balancing Heat and Power

PROBABLY no subject is of greater current interest to the industrial plant than the balancing of heat and power, so that a paper on this topic by R. V. Kleinschmidt, research engineer of Arthur D. Little, Inc., was received with much interest. The purpose of the paper was to indicate the importance of various factors in increasing the amount of byproduct power that can be generated in industrial plants using process heat. The problem of balancing heat and power resolved itself into the problem of generating from the process heat the maximum byproduct power that could be used economically. Attention was called to the opportunities for economy presented in increased boiler pressures, high superheats, and particularly by reducing the back pressure on turbines and engines to the lowest possible point. Utilization of waste heat from furnace gases offered an opportunity for additional power generation in mixed-pressure or low-pressure condensing turbines, and it was shown that hot air could be used economically by returning it to the boiler furnace and heating whatever air might be required for process work with exhaust steam.

Under utilization of waste heat, special attention was given to water heating, as it was considered that this was an important field for the improvement of the heat-power balance. The old idea that water heating with live steam is 100 per cent efficient because all the heat units in the steam appear in the hot water, was considered obsolete when viewed from the standpoint of byproduct power.

Two curves were presented giving

C. L. CLARK

the results of a detailed analysis of the problem of water heating, one showing the advantages of two-stage water heating as compared with heating by exhaust steam only, and the other giving the best condenser vacuum for various initial and final temperatures of water in a two-stage process. The author emphasized the importance of an adequate study both of the heat and power requirements of the process, and of possible improvements or alterations of the process as a basis for the improvement of the heat-power balance.

Discussion of this paper emphasized the necessity for careful engineering studies of each industrial plant in order that the highest economy of heat and energy generation and utilization may be realized. The process of manufacture used in the industry must be studied, and sometimes this will show that certain changes in operation or schedule can be made that will permit of greater economies. Also, it is not only necessary to suit the power equipment to present requirements but cognizance must be taken of changes and developments likely to occur during the succeeding ten or fifteen years.

The possibility of adjacent location of steam and power using industries so as to get increased economy from the more complete utilization was brought out. As an alternative, purchase of steam from central stations and sale of excess electricity to central stations presents attractive opportunities.

Heating of water for process and also the use of the steam accumulator permit of better balance being attained in many plants. The plant can be designed for balance under normal conditions, using one or both of these devices and, when excess heat is required steam can be reduced through valves.

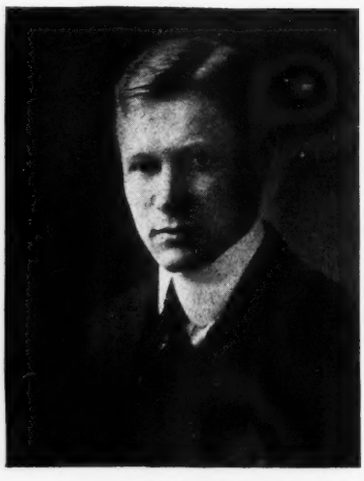
In other plants the purchase of some power permits of better balance, while those with high steam demands may well sell power. It was hoped that public utilities would recognize this condition and co-operate by adapting their rate schedules.

Piping Design to Care for Expansion

TO AVOID excessive moments at the joints that would damage them and cause leaks, excessive reactions that would damage anchors and apparatus and excessive stresses in the pipe, a study of the flexibility of piping is important. Present methods of design consist largely of empirical rules and judgment of the designer as to the looks of the layout. Long experience with moderate pressures and temperatures has developed designers who can tell by the eye alone whether or not a given pipe line is sufficiently flexible. The higher temperatures now in use and the heavier pipe walls used with higher pressures have rendered this method of design highly untrustworthy.

To reduce the subject so far as practical to a rational basis, W. H. Shipman, of the editorial staff of the *American Machinist,* presented, at the session on central-station power, a paper giving the fundamental principles of design, a complete mathematical theory of piping subjected to expansion and a summary reducing the complicated results to a simple usable basis. The following eight principles of design were proposed and elaborated throughout the paper:

Making the entire pipe line the expansion bend; computing or estimating the shape of the pipe line after expansion and then placing the supports so they will not interfere with the natural movement; considering the shape most efficient in which the maximum length is working at the maximum safe stress; excessive bending movements at the joint are more likely to cause trouble than excessive stresses in pipe walls; cold springing of the piping to facilitate erection, to reduce expansion stresses and to reduce the distortion of the system; flattening of curved portions and end conditions as factors influencing reactions and stresses, and variation of physical properties with temperature.



W. J. WOHLENBERG

Influence of Coal Type on Radiation

AS A valuable guide in furnace arrangement and analyses of combustion methods, W. J. Wohlenberg, professor of mechanical engineering, Sheffield Scientific School, and R. L. Anthony, laboratory assistant, presented a valuable paper including the results of an application of the methods and data given to the society in a previous paper ("The Influence of Radiation in Coal Fired Furnaces on Boiler Surface Requirements, and a Simplified Method For Its Inclusion," by W. J. Wohlenberg and E. L. Lindseth) to pulverized coal for a number of coals of widely varying composition. After an evaluation of radiation quantities for each of these coals, including a large number of furnace flame and refractory isotherms for the several coals, curves plotted in three different ways to show the variation in the rate of heat transfer at the water-cooled furnace wall and isothermal and iso-transfer curves to show the relation between the calorific value of a coal and the required energy-release rate for a given flame temperature, the authors summarized the results of further investigation made for the purpose of ascertaining what quantitatively measurable property of coals might be most significant in differentiating one from another during combustion with respect to the quantity of energy that is transferred to the walls of the boiler furnace. Of the properties investigated, it was found that the calorific value served as the most consistent and useful indicator of the radiation powers of a coal as burned in the pulverized form in boiler furnaces. In an appendix the authors showed the relation between heat transfer rate per square foot of surface and radiation energy equations.

Peak Load Problems in Steam Stations

UNDER the foregoing title A. G. Christie, professor of mechanical engineering at Johns Hopkins University, dealt in a practical way with the problem of carrying the maximum peak loads of the year in steam power plants. The use of the load duration curve for the purpose of studying annual peak loads was analyzed and the conclusions drawn that, first, a plant intended for annual-peak-load service should be installed only at the lowest possible first cost and, second, that the economy of peak-load equipment could be sacrificed to secure low initial cost.

Of the various plans that he proposed to provide equipment for carrying the annual peak loads, the three that appear most promising are those involving the use of steam accumulators, of peak-load units, and of present plant after new base-load equipment had been added.

To indicate the possible annual savings through the application of these three methods, the author assumed an electric system with a maximum annual peak load of 200,000 kw., together with certain data, for annual load factors of 65, 45 and 25 per cent on this system. With assumed plant costs, fuel costs and operating performances, an analysis was made of the annual operating costs of the various methods, and the possible annual savings through the use of steam-accumulator plant or peak-load units were shown in a series of curves.

Conclusions reached were to the following effect: With the assumed cost data and a triangular peak, the steam accumulator lost its advantage if the base of the peak that it was to carry exceeded four hours. Calculations in-

dicated that peak-load units were less economical than an accumulator plant except in the large sizes. On the other hand, the availability of peak-load units for emergency service, particularly in the case of long sustained peak loads on dark days, was greater than that of the accumulator. The same degree of availability might be secured on the accumulator turbine by making it a mixed-pressure unit.

Load-duration curves of systems with broad, flat, daily peaks might show a certain portion of the annual peak that has a low annual load factor. The long duration of such daily peaks would favor the installation of a peak-load plant in preference to steam accumulators.

A steam-accumulator plant could carry peak loads other than during the annual peak, and this would lead to station economies due to the operation of fewer boilers and standard turbines. The charged accumulator also is available for emergency during off-peak hours such as thunderstorm peaks, fogs, etc. The charging of the accumulator with steam during the night would improve the load on the boilers, and this should lead to more efficient boiler-house operation during that period. Accumulators required little maintenance and repairs, so that this cost should be less than for the equivalent capacity of the boiler plant, and as they were subject to little wear and tear, the rate of depreciation also should be less.

With its lower first costs the accumulator saved in fixed charges. The base-load plant saved fuel. The net savings depended on the relative values of these two savings, which might amount to a large sum of money.

It was important that steam accumulators and peak-load units effected their largest savings when added to a system consisting of a standard plant with modern equipment only.

A second striking fact was the large margin of saving that may be secured by the use of accumulators in place of a base-load plant to carry annual peaks with any plant combination when the annual load factors are low.

As a third point of interest, the author predicted that the lower the price of coal, the larger would be the accumulator savings in systems with old and mixed plants. This resulted from the fact that the value of the fuel saving effected by the addition of base-load units was less with low-priced coal than with expensive coal.

In the discussion which followed Professor Christie's paper, several speakers, while conceding a place for the steam accumulator in the industrial-plant field, were averse to its application to central-station power plants. It was urged that inasmuch as there was no such thing as a plant remaining a base-load station for any considerable time, there was necessarily much of the older equipment always on hand that would be available for peak-load service. In fact such equipment had to be placed in this class long before it could be written off the books. It was pointed out further that, with a proper inspection and maintenance schedule requiring units to be taken out of service for certain periods yearly, reserve capacity was necessary during such periods equal to the largest unit in the plant. The steam accumulator could not be substituted for this. Moreover, the present-day boiler practice gave a relatively flat load curve over a wide range and thus enabled, so far as the boiler room was concerned, the carrying of peak loads at high economy.

Progress in Steam Power Engineering

THIS report, contributed by the Power Division, of which Vern E. Alden is chairman of the executive committee, indicated a great deal of intensive work in the consolidation of gains incident to past progress and the raising

A. G. CHRISTIE

of the average standard of steam-station design and operation throughout the country. One of the most important factors that had contributed to rapid progress was the free exchange of ideas and the pooling of operating experience through the medium of the Power Division of the American Society of Mechanical Engineers and the Prime Movers Committee of the National Electric Light Association. Some major objectives that had been attained were as follows:

The types of fuel preparation and burning equipment that were available, permitted the efficient burning of coal varying in grade from lignite to anthracite, and the burning of coals of widely varying grades in a single installation.

Fuel-burning equipment, boilers and accessories were available that permitted the generation in a single unit of the steam required for a 75,000-kw. turbine.

Single-cylinder turbines of 75,000-kw. capacity, tandem-compound turbines of 160,000-kw. capacity, and cross-compound turbines of from 200,000 to 300,000-kw. capacity were available.

Equipment was available for operation at steam pressures up to 1,400 lb. per sq.in. gage and steam temperatures up to 750 deg. F., with considerable evidence to indicate satisfactory operation at even higher temperatures.

Equipment could be had for the reheating of steam withdrawn from the lower stages of the turbine, using either the heat from flue gases or the latent heat from high-pressure steam.

There was available equipment for heating feed water by means of the regenerative cycle, using from three to five stages of heating.

Furnace water-wall construction eliminated to a great extent the use of refractories in the portions of the furnace walls that were subjected to the highest temperatures.

Condensing equipment would maintain high vacuum with low investment and operating costs.

Economizers and air heaters reduced the losses in the flue gases to low values; and the investment and maintenance incident to the use of this equipment were reasonable.

There were available mercury-vapor-steam units capable of developing up to 20,000 kilowatts.

Combustion-control equipment could be obtained that would maintain day in and day out in the boiler house, operating efficiencies closely approximating test efficiencies.

For the average power station it had been possible to reduce the makeup water to approximately one per cent, which could be evaporated easily with an inappreciable loss due to the degrading of heat. For boiler plants requiring a high percentage of makeup, equipment was available that made it possible to maintain conditions of operation and a degree of reliability and availability of boiler units closely approximating that for boilers operating on distilled water.

Coal- and ash-handling equipment now available was conducive to low labor costs.

Assuming favorable conditions, the committee pointed out that it was now possible to produce power, by using the straight steam cycle, with 12,500 B.t.u. per kw.-hr. of net send-out, and, assuming the same favorable conditions, to produce power with from 11,000 to 10,000 B.t.u. per kw.-hr. of net send-out by using the mercury-vapor-steam cycle of generation.

While it was interesting to speculate as to the possibility of future developments in research that would lead to the reduction in fuel consumption per unit of output, it would be more profitable and more effective in the reduction of the costs if the entire field concentrated on a study of the best use of the knowledge and the equipment that were now available. Problems suggested for study and enlarged upon in the report related to reliability, investment, reserve capacity and the date of starting new power-station extensions, size of units and stations, interchangeability of equipment and production in development costs, quality of fuel burned, location, simplification and ease of operation.

Hydraulic Sessions Feature Research

This year two full sessions were devoted to hydraulics with papers dealing with flow in pipes, pump and turbine research, and the maximum pressure rise in closed conduits. The progress report of the division revealed outstanding recent trends as economic rather than mechanical.

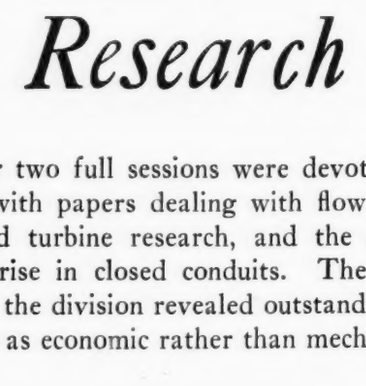
Flow in Pipes

A HIGHLY technical paper on this subject, read by title, had been prepared by Michael D. Aisenstein, hydraulic engineer of the Byron Jackson Pump Manufacturing Company. Following an introduction distinguishing between streamline and turbulent flow, the author derived general formulas for the friction drop in circular straight pipes, based on experiments of different authorities, for both types of flow. The general equations developed were rewritten into a number of formulas for practical use and application was demonstrated by working out a number of problems that may readily occur in practice.

European Hydraulic Turbine Research

IN THIS paper Blake R. Van Leer, assistant secretary of the American Engineering Foundation, called attention to the difference in general attitude toward hydraulic turbine research in Europe and in America; reviewed a paper on "Experimental Research In The Field of Water Power," by Dr. D. Thomas, as the best material available giving the European viewpoint, mentioned the hydraulic laboratories of Europe doing work in this field; briefly summarized the European status on model to full-scale efficiency formulas, draft-tube research and cavitation, and then discussed two distinctly European turbines, the Kaplan and the Banki.

The Kaplan turbine is a high-specific-speed propeller type of machine in which the propeller blades may be adjusted externally by means of a servomotor actuated by the governor while the turbine is in motion. For the present a head of 50 ft. is regarded as a safe upper limit for this turbine. The author outlined the field of this turbine, stated its advantages and disadvantages and listed some 53 installations now in operation. He also outlined the theory of the Banki turbine along with several design formulas and comments on its field of operation. Its chief advantages were efficiencies of over 85 per cent even for small units, relatively high speed on low heads, simplicity of construction and cheapness in building.



S. L. KERR

Pressure Rise in Closed Conduits

ON THIS interesting and important subject S. Logan Kerr, assistant chief engineer of the I. P. Morris Corporation, discussed the various elements entering into the determination of the true maximum rise in pressure that may occur in closed conduits. Contrary to the usual belief, he showed that the maximum rise in pressure would not be produced necessarily when the full flow in a given conduit was cut off, but was a function of the initial flow from which the deceleration started. The necessity of establishing the relation between the average conduit velocity and the rate of gate travel for various proportional strokes was cited. A comparison was made of the computations by several of the accepted methods based on the elastic-wave theory, and a translation included of important studies made by M. Maurice Gariel in France. The author outlined the application to practical cases and worked out in detail specific examples. A valuable feature of the paper was a general summary of water-hammer computations, with several simple formulas for the rapid calculation of the critical conditions.

Tests on Small Rotary Pumps

RECOGNIZING the scarcity of published information on the behavior of gear pumps and other small rotary pumps used for supplying lubricating oil, cooling water and other liquids to all kinds of machines, and especially to machine tools and steam and internal-combustion engines, particularly under a variety of pressures, speeds and oil viscosities, F. Aschner and L. Mattheus, of Berlin, Germany, presented, largely in curve form, performance and efficiency tests on such pumps under various working conditions that had beeen made in the mechanical laboratory of the Technical University of Breslau. These tests were conducted on the usual types of lubricating pumps, such as the rotary piston pumps used on the Hispano-Suiza machine and gear pumps for machine tools and automobile engines. Of the data obtained, values of volumetric efficiency of the pump were considered important in design problems, as each moving part of the main engine required a definite quantity of oil per minute for proper lubrication, and certain engines, particularly of the internal-combustion type, would be affected seriously by too much lubrication. The volumetric efficiency was influenced by two principal factors, the viscosity of the pumped oil and the clearances within the pump that were due to design, manufacture and wear. Another important factor in connection with gear pumps, was the effect of eddies formed at the discharge side by the operation of the gears. Comments followed on test results and the general operating conditions to which the different types of pump were best adapted.

Dredge Pump Thrust Loads and Pressures

THE wide variation of nearly two to one in the estimated thrust load secured during the design of certain dredge pumps led J. H. Polhemus and James Healy to make tests to determine the various factors that affect thrust and to determine a method of estimating these loads. The results of this work were presented in a paper, "Dredge Pump Pressures and Thrust Loads." Pressure readings were taken at varying distances from the pump shaft to determine the existing pressure conditions both in front of and back of the impeller. The estimated thrust was then calculated by adding the thrust caused by the suction pressure to the thrust caused by the pressures acting on the back of the impeller and subtracting the force caused by the pressure acting on the front of the impeller.

A study of the effect of clearances showed that a close clearance in the back was more important in obtaining low thrust loads than a close clearance in the front of the impeller. Operating with close clearances both front and back, a high pump efficiency is maintained, but not the lowest thrust load. It was found that relief holes in the back of the impeller tended to decrease the thrust load considerably, and that higher heads produced maximum thrust.

In the discussion R. L. Daugherty pointed out that the dynamic force caused by turning the water 90 deg. as it enters the pump impeller had been entirely neglected in estimating the total pump thrust. This force, he said, was sometimes large enough to cause a complete reversal in direction of the thrust load.

Hydraulic Progress

CONTRIBUTED by the Hydraulic Division, with Ely C. Hutchinson, chairman of the executive committee, the report this year had no outstanding new developments or trends in machinery or methods, and few changes in practice, but the intervening period since the report of 1927 had shown particularly an increased striving to approach the goal of perfection in economy of design and operation. Theoretical maximum efficiencies already had been approached in the turbine field, recent reaction-turbine tests having shown efficiencies up to 94 per cent, although there was a larger margin for improvement in part-gate turbine efficiencies and in pumping equipment.

The past year was notable for the important hydraulic-power plants that were put into operation, but these had been in the making for several years and comparatively few important projects had been undertaken recently in the United States owing to a variety of reasons.

In the hydraulic power field the outstanding recent trend had been economic rather than mechanical; that is, the best efforts of power engineers, manufacturers of equipment, and users thereof were being devoted to lowering the cost of water-power development, improving the economy thereof and working out the best economic use of water power in co-ordination with steam power.

With the growth of interconnection the all-hydro-electric generating system was becoming a thing of the past in the United States. The combination of hydro and steam power made possible the economic justification of many otherwise impracticable water-power projects. As the efficiency of hydraulic power generation had approached already the theoretical maximum, it was not possible to meet steam competition by improvement in efficiency alone, so that recourse must be had to lowering the investment cost through simplification of layout, elimination of non-essentials and improvement in design; to the extensive overdevelopment of streams with respect to minimum dependable flow and continuous capacity; to the use of additional steam units to carry load increments until such time as the load had grown sufficiently to absorb the output of the next hydro-electric step; and to realizing, utilizing and capitalizing the advantages of hydro other than its energy-replacement value.

B. R. VAN LEER

A noteworthy current activity had been the revamping and in some cases the complete reconstruction of old hydraulic plants. In the West there was an encouraging tendency to effect cooperation between irrigation districts and power companies.

The completion of the principal tests on the Stevenson Creek Arch Dam and the publication of data and findings had done much to put the design of thin-section, and particularly arched, concrete dams on a scientific basis. As a result of research work and experience there was increasing confidence in less-than-gravity-section types of dams. Rock-fill dams with thin reinforced-concrete faces were on the increase, and much study had been given to the design of dam aprons to prevent erosion of the foundation at the toe. The tendency to install permanent and substantial crest gates on dams rather than renewable flashboards was on the increase, but there still remained considerable room for improvement in the design of deep-crest gates and their operating mechanism to insure simple and reliable operation and low maintenance as well as investment cost.

In the turbine field probably the outstanding current development was the adjustable-blade runner. By changing the turbine blade angle automatically, high efficiency was obtained at part load, thus overcoming the principal disadvantage of the propeller-type turbine.

As a part of the year's progress mention should be made of the advance in the design of impulse wheels. Governors were being equipped with new control devices to adapt them for automatic or semi-automatic plant operation. On new installations the electric governor drive was becoming more common.

There had been a notable development and use of equipment for the semi-automatic or remote control of individual generating units within a station and for the automatic operation of the plant as a whole. The overlapping of the heads of plants in series on the same stream was becoming more common, and as a means for reducing the first cost, the so-called outdoor or semi-outdoor type of station had been adopted recently in several instances.

Last year's report pointed out that the troublesome problem of penstocks for high-head plants apparently had been solved. It was interesting to note that the three plants in America with the highest heads, running from 2,381 to 2,562 ft., had used band-reinforced steel pipe, consisting of a welded steel core around which were shrunk seamless steel bands. With these bands the thickness of the lap-welded core could be kept within limits that insured good welds.

Much attention was being given to power-house-crane design, long-distance water-level gages, continuous or intermittent water measurement by the use of venturi sections, etc., the removal of trash on racks by mechanical rakes, the prevention of ice accumulation on racks and turbine parts by electric heating, electric means of keeping fish from entering intakes, and mechanical fish elevators.

Progress in centrifugal pump design had been similar to that in turbine design in the application of high-specific-speed runners of propeller or semi-propeller type in the range of low or moderate heads.

There had been a great increase in recent years in laboratory experimental work and field testing. Several power companies as well as all the principal manufacturers now had well-equipped laboratories. There was an increasing use of models, not only for testing turbine performance, but also for determining the proper design and layout of intakes, casings, draft tubes, valves, and even of an entire project, all reproduced to scale.

Review of Fuels and Fuel Preparation

Radical differences of design in coal pulverizers raised the question of correct fundamentals. Advantages of confining guarantees on performance to a simple code. Progress in the fuel field had been mostly improvement in details.

Coal Pulverizers

IN THIS paper W. J. A. London, consulting engineer, of Walden, N. Y., emphasized the fact that commercial coal pulverizers varied greatly in their performance. While there were the two principles of attrition and impact on which pulverizing mills were based, there were such radical differences of design as to raise the question of correct fundamentals. An analysis of the designs of the different mills showed that while attrition mills, comprising those of the ball and roller types, operated on substantially the same principle, there seemed to be a difference of opinion among the designers of impact or hammer mills as to the proper or most efficient way of attacking the problem. A brief review of some of the more generally used machines was made with the object of pointing out the radical differences in design.

An analysis of what actually takes place in impact mills during operation led to the conclusions that in any so-called impact mill the actual work done by impact forces was relatively small. In hammer mills, where the no-load power or windage losses vary somewhere between the square and the cube of the speed, were high-speed hammer losses warranted? They were probably doing little hammer work, and the velocity energy created by the hammers rotating at high speed was only producing velocities necessary for attrition that might be accomplished in a more efficient and scientific way.

A considerable part of the paper was devoted to the subject of guarantees and their relation to subsequent performances in the field. According to the author it was hard to conceive a more difficult engineering problem than the determination with any degree of accuracy of the exact performance of a coal pulverizer. Friability, moisture, load and fineness all materially affected the horsepower per ton. With all these variables it was difficult to see how a purchaser could expect to get any reputable manufacturer to give guarantee unless he himself was in a position to furnish all the data necessary for the making of such guarantees.

Several reasons were advanced as to why performances and comparisons based on a 200-mesh standard were neither logical, reliable nor of any great value. It was the author's conclusion that until more was known about the art of pulverizing coal, the builder should be honest with the purchaser in any guarantees he made. Engineering judgment indicated that guarantees should be confined to the following simple code:

1. Guarantees for power per ton and maintenance to be based on one accepted standard grade of coal.
2. Moisture content under guarantee conditions must not exceed 5 per cent.
3. Fineness guarantees to be based on 99.5 per cent through a standard 40-mesh screen.

In the discussion of Mr. London's paper the desirability of performance guarantees, from the user's viewpoint, was emphasized, inasmuch as the type of the plant was often predicated on this information. Moreover, unless guarantees were made, there would be less incentive to obtain best performance. That few manufacturers really knew what their mills would do, under all conditions, was admitted, it being pointed out that the capacity might be doubled with one kind of coal over that with another, or that a mill might not produce the expected capacity with a given degree of fineness. The large variation in power consumption, with different coals, was due to the varying hardness, friability and moisture content, the surface moisture rather than the total moisture being the important factor. Moreover, the shape of the particles would differ with different coals and different ingredients of the same coal. It was pointed out that too much 40-mesh fineness would be undesirable where cold wall furnaces were used. In such cases a large percentage of superfineness was most desirable.

Progress in Fuels

IN GIVING the Progress Report for the Fuels Division, Prof. J. T. Ward pointed out that the year had witnessed few radical changes. Progress had been mostly in improvements of details. He referred to the three large fuel meetings, namely, the National Fuels Meeting in Cleveland, the Pittsburgh Fuel Conference and the London Fuel Conference, as evidence of the importance being attached to the subject.

The production of bituminous coal had been about five million tons, which was somewhat less than that of 1927 and 1926, the decrease being due probably to the accumulation of stocks and improved efficiency.

In the coal industry there had been a noticeable increase in the mechanization of mining methods during the year, and greater attention had been given to coal preparation. The anthracite industry had been carrying on considerable research with a view to stimulating further use of small sizes in order to meet the increasing competition from oil and bituminous coal. From now on, more and more anthracite would be taken from mines that produce a greater percentage of fine sizes which must be disposed of at a profit.

In the field of high-temperature carbonization the dehydration of gas and dry quenching appeared to be the two outstanding developments. Low-temperature carbonization was making some progress, but so far there was little information available to indicate that it had attained a commercial basis. Considerable research was going on regarding the conversion of low-temperature tar into materials of higher form value.

In the power-plant field there was an increased tendency toward water-cooled walls, combustion control, greater reliability of stokers and the use of turbulent burners for pulverized coal. Reference was made to progress in the use of pulverized coal for marine purposes.

H. W. Brooks, who was one of the A.S.M.E. delegates at the recent London Fuels Conference, reported on that meeting. He spoke of the attention that the British were giving to research in fuels, because of the economic dependency of England upon her coal industry. There were at present sixteen low-temperature carbonization plants commercially operated in England, and these plants found a ready market for the coke from low-temperature carbonization, which especially was suitable for the chain grates so widely used in England. The speaker referred to the elaborate program of power development being carried on by the Soviet government in Russia in which pulverized coal was used exclusively. Furthermore, the Russians had made an appropriation of three million rubles a year for research work in the power field at the Technical Institute in Moscow.

Oil-Engine Status Reviewed

In former meetings the presentation of two or three papers at the Oil and Gas Power Session reduced the time for discussion to a point where many of the engineers felt that a change should be made. In addition to the progress report of the Division, this year only a single paper was presented, leaving ample opportunity for discussion.

Oil Engine Performances

THE question as to how engines of different manufacturers are to be compared with respect to capacity is a subject of vigorous discussion in Diesel engineering circles. In this paper, Otto Nonnenbruch, De La Vergne Machine Company, explained that upon examination of a number of reliable tests on Diesel engines he found that the friction load was constant over the entire load range and that the fuel consumption per indicated horsepower at low indicating mean effective pressures was practically the same for all types of engines, being approximately 0.028 lb. per hp.-hr. In addition he found that the indicated fuel consumption increased almost in proportion to the increase in indicated horsepower. These facts make it possible to direct the indicated fuel efficiency from the brake fuel consumption without the measurement of the indicator diagram.

He suggested that the commercial fuel load rating of an engine be set at the point where the fuel consumption was 0.315 lb. This is approximately the present method.

In a written discussion Captain Gatewood, of the Shipping Board, pointed out that while the rating method of Mr. Nonnenbruch might hold good for an engine operating at a constant speed, it could not be applied to marine engines of variable speed. In the latter engines the frictional loss was by no means constant, and in the tests conducted on a 4,000-hp. two-stroke-cycle double-acting engine, with the speed varying from 95 to 67 r.p.m., the friction load ranged from 1,200 to 600 hp. Even at constant speed the variation was over 10 per cent.

Herman Lemp, Ingersoll-Rand Company, was rather inclined to support the conclusions of the original paper based on his experience several years ago. As a rough check he believed 0.28 lb. of fuel per i.hp., was a fair value.

While the plan left much unsettled, Edgar J. Kates believed that it provided a rough test method.

The opposite view was expressed by C. S. Kenworthy, Worthington Pump & Machinery Corporation, who declared that the method was worthless as a means of rating an oil engine. In the first place, he pointed out in one illustration the tangent to the curve was unfairly located and, if placed properly, would have destroyed the major premises of the paper. It had been found that in one engine the average fuel consumption was 0.33, while in another it might be far below this value.

J. W. Anderson felt that the low-load points were not sufficiently low to justify the location of the friction load consumption.

JULIUS KUTTNER

Progress Report

STIMULATED by a notable drop in the price per horsepower, general Diesel-engine sales, according to the most recent biennial census, have shown a marked tendency to increase, according to Julius Kuttner, who presented the report. The enumeration for 1921 showed only 330 oil engines aggregating 89,039 hp., whereas in 1925 the American output had risen to 4,101 engines totaling 400,390 hp. The 1921 census assigned $93 as the average value per horsepower, a figure which fell to $68 in 1923 and $54 in 1925. A recent unconfirmed report stated that during the summer of 1928 engines of a high-grade standard make were sold by the manufacturer at a price of $45 per horsepower.

The strong recent trend toward the manufacture of small-unit Diesel engines was supported by the Census, according to which 45 per cent of the engine output for 1925 was rated at less than 50 hp. per unit. In 1923, on the other hand, engines from 100 to 590 hp. were in the lead, with units from 50 to 100 hp. a close second.

There was a marked contrast between the development of the American marine Diesel engine and the European. Of the total tonnage delivered by American shipyards in 1926, only 15 per cent were Diesel-driven, and in 1927 this proportion increased by 6.5 to 15.5 per cent. The same two years showed an increase from 30 per cent to 45 per cent in the proportion of American steam vessels to the total of American vessels constructed. In the world at large, on the other hand, the year ended in March, 1927, showed steam construction of 919,000 hp., substantially equal to motor construction of 918,000, while in March, 1928, the world's motor-vessel output had risen to 1,133,000 hp., and its steamship construction had fallen to 807,000.

What promised to be a really significant innovation in naval engineering was the use of Diesel engines as cruising power for large war vessels.

The use of Diesel engines for automotive service appeared to be marking time, particularly in the United States.

In the discussion following the presentation of the Progress Report, Herman Lemp took issue with the statement that the oil-electric locomotive cost about 50 per cent more than a steam locomotive. He pointed out that the greatest load was at starting and to give equal drawpull at starting, a steam locomotive would need to be so built that when up to speed it was operating far below capacity.

E. C. Magdeburger, of the U. S. Navy Department, felt that too little had been said about the trend to lighten weights, citing the 11,000-hp. Hamburg Diesels, which weighed but 55 lb. per hp., as examples of the drift. Higher speeds were the order of the day, he claimed, and the use of dampers and vibration eliminators removed all danger of serious torsional vibration.

Doctor Sperry, the new president of the Society, addressed the audience briefly. With his experience of some 30 years, he was deeply interested in oil-engine developments. Supercharging would soon be universally adopted to the decided reduction in initial cost of a given powered engine.

Research Activities Show Progress

Active research on boiler feed-water purification awaiting the assurance of entire fund for five-year program. Steam-table research progressing. A revised Mollier chart for steam, extended to the critical point, now available. Papers in the fluid meter session deal with orifice and nozzle flows and orifice steam meter coefficients.

Boiler Feed-Water Studies

THROUGH the Joint Research Committee on Boiler Feed-Water Studies it will be recalled that six national technical organizations are co-operating in a study of the various processes employed in the purification of feed water in steam power plants and on railroads. This research is being carried on to determine the fundamental principles underlying certain phenomena that take place in boilers. During the last year the functioning of the committee has been along the lines originally laid down when these studies were inaugurated, the aim having been to collect information and data on various phases of feed-water treatment and allied subjects.

Considerable effort had been given during the year to the accumulation of the fund for carrying on this research work. No active research is planned until the entire fund is available, $60,000 annually for a five-year period, since the successful promotion of the work must depend upon an uninterrupted program with assured financial assistance.

Committees on filtration, corrosion, water softening by chemicals, evaporators and condensers, and embrittlement had reported progress, but no formal reports were available from these groups this year.

Subcommittee No. 3 on zeolite softeners, internal treatment, priming and foaming, reported an extended experimental study of film formation in water solutions at Ohio State University, following the working hypothesis on this subject advanced in last year's report. The study was completed too late to be written up for the meeting, but it was reported that this hypothesis had proved of value in research and might perhaps be raised to the dignity of a general theory of film formation, although it was emphasized that laboratory experiments in glass vessels could not solve the industrial problems of boiler water chemistry. Experimental and full-sized boilers must be used to reach decisive results.

Subcommittee No. 7 on municipal water supply in relation to boiler use, reported accumulation during the year

S. T. POWELL

of data on this subject which clearly indicated the important effects of trade-waste pollution upon the quality of water that is supplied for boiler-feed use and for cooling water in surface condensers.

For control of the problem the following specific recommendations were made by the committee: Co-operation with state and federal bureaus in intelligent study, leading to constructive legislative enactment for general stream pollution control; collection and interpretation of steam-station records to determine the effect of trade-waste pollution on the cost and operation of boilers, condensers and allied equipment; co-operative study by steam-station operators of surface water in areas grossly contaminated to allocate the source and degree of trade-waste pollution; distribution of scientific literature on trade-waste control to industries responsible for such pollution; enlisting the interest and co-operation of industries contributing to the pollution of surface water.

Subcommittee No. 8 on standardization of water analysis had devoted its efforts to a satisfactory test for dissolved oxygen in boiler feed water. The Winkler method, as it is called, was presented as a tentative method for trial and criticism by the various industries represented by the joint societies, although it was reported that the method had been accepted by the N.E.L.A. chemists committee as a tentative method of that group and was being used in a large number of steam stations.

The Winkler iodimetric method depended upon the liberation in the solution of an amount of iodine exactly proportional to the amount of oxygen dissolved. Chemically it amounted to the oxidation of the manganous-chloride solution to manganic acid by the oxygen present, and the subsequent reduction of iodide by the manganic acid. The starch indicator showed the presence of iodine, and the standardized solution of sodium thiosulphate had a definite iodine absorbing value. The calculations by the formula were in terms of oxygen, but the intermediate steps were computed in terms of iodine.

Subcommittee No. 9 on bibliography reported preparation for publication during the year of eight series of bibliographies including 244 articles or papers on water treatment for industrial uses or allied problems.

Steam Tables Research

AT the steam tables research session George A. Orrok, chairman of the executive committee, reported a total expenditure up to the present of about $72,000. Of this sum $15,000 had been spent at Harvard University, $20,000 at Massachusetts Institute of Technology and $30,000 at the Bureau of Standards. Mr. Orrok said that his trip to Europe during the past year had resulted in an understanding with the foreign investigators that a final steam table would not be published until international agreement had been reached.

Progress of work at the Massachusetts Institute of Technology was reported by F. G. Keyes and the work at the Bureau of Standards was reviewed by N. S. Osborne.

A revised chart for steam, extended to the critical point, was presented by J. H. Keenan, Hoboken, N. J. The Harvard Joule-Thomson effect experiments which extend to 565 lb. per sq.in. at 657 deg. F., had been carefully studied and reformulated by Doctor Davis during 1926 and 1927 and were used in the development of this chart. The

Knoblauch specific heat measurement extending to 420 lb. per sq.in. was used to supplement the Harvard data. The experimental determinations by Doctor Keyes and Doctor Smith at the Massachusetts Institute of Technology on the specific volume of supherheated steam between 1,350 lb. per sq.in. and 3,850 lb. per sq.in., and between saturation and 732 deg. F. constitute the basis of the tables between 1,000 lb. and 3,500 lb. per sq.in. Two important pieces of data were contributed by the Bureau of Standards, namely, the mechanical equivalent of heat reported by Doctor Osborne of 1 B.t.u. = 778.57 ft.-lb., and the total heat of saturated water between 32 deg. F. and 482 deg. F.

In discussing the steam tables, E. F. Mueller remarked that the mechanical equivalent of heat was not a fundamental constant. He moved that it be the opinion of the section that all kinds of energy be expressed in the same unit. The motion was seconded by Doctor Davis, president of Stevens Institute, who suggested that the kilowatt second be the unit used. The motion was passed after discussion.

A highly technical paper was presented by R. C. H. Heck, of New Brunswick, N. J., in which he compared experimental data with several equations expressing the pressure volume and temperature relations for steam. The comparison showed that within definite limits an equation could be written that closely followed experimental results, but that in the higher pressure and temperature ranges such an equation departed decidedly from experimental data. The investigation did not offer a working equation nor did it open up an optimistic view as to the probability of a closely fitting general equation for steam.

Orifice Steam-Meter Coefficients

ALTHOUGH the value of the thin-plate orifice as a fluid meter had been established beyond all question and there were many successful commercial applications, Robert W. Angus, professor of mechanical engineering, University of Toronto, recognized the fact that there was a great scarcity of tables of actual orifice coefficients, these apparently being retained by the manufacturers. Recently, the author had been conducting some tests on a steam turbine of about 100-hp. capacity which was not equipped with a surface condenser, and as it was connected to the main header from a large battery of boilers, the feed-water method of measuring the steam consumption was not available. An orifice meter was used, and after making the turbine tests, the orifice was set up in the steam laboratory, calibrated and then used to determine the coefficients under a wide range of conditions. A summary of the results of this work is given in the paper.

In the discussion J. M. Spitzglass expressed the belief that reliable results could not be obtained with the type of set-up used by the author. His main objections being the location of the orifice with respect to the entrance of the test section of straight pipe.

Test Code for Water Cooling Equipment

ON TUESDAY afternoon a session was devoted to a public hearing on power test codes, dealing this time with the testing of water-cooling equipment in general use for the cooling of comparatively large volumes of water required for power or industrial purposes, and in which the major cooling is done by evaporation. The equipment covered was as follows: Chimney or natural-draft cooling towers, forced-draft cooling towers, spray installations, and natural and artificial ponds and reservoirs. As is usual in these codes, attention was given to the following items: object, instruments and apparatus and their location, general precautions, preparation, operating conditions, and calculation of results with a typical form for recording the test data.

R. W. ANGUS

A large number of written discussions were presented, most of which were read by P. E. Reynolds, secretary of the committee. Many of these called attention to minor typographical errors.

A long detailed discussion was presented by B. H. Coffee. Some of the main suggestions which he made were the elimination of four paragraphs that detailed the method of operating a sling psychometer and in their place insert a reference to the code on instruments; the inclusion of a statement that guarantees should contain curves that would permit correcting performance of the equipment to meet any existing wet bulb temperature, and also that the heat balance calculations should be applied only to the natural and mechanical draft cooling towers.

Flow Measurement

THE special research committee on fluid meters of the society had requested for presentation at this session a paper on "Flow Measurement," by John L. Hodgson, of Bedfordshire, England, who is an international authority on the orifice measurement of fluids. In his presentation the author summarized all the work which is now of importance that had been accomplished by him during the last twenty years, including abstracts from many articles and papers that he had published on the subject in England. The paper did not enter into detail with respect to the work he had done in designing actual flow-measuring devices, but turned more to fundamental consideration upon which all differential flow meters must be based.

A rather lively discussion developed that concerned the application of the method of dimensional analysis to fluid flow. P. S. Smith expressed the opinion that it was the only rational method while J. M. Spitzglass apparently held the opinion that its use for steam flow measurements was unnecessary and confusing.

Pressure Vessels

FOR some time a joint committee of the A.S.M.E. and the American Welding Society has been laying plans and raising funds for an extensive series of tests of welded pressure vessels.

Definite progress became evident at a meeting of the committee on Monday morning. A modification of the original program was adopted, cutting the number of tanks to be tested down to a total of 66, and two thicknesses. This move, it was pointed out, will reduce the cost of the investigation two-thirds and still give all data required by the Boiler Code Committee. The revised estimates of funds required gives a total of thirty thousand dollars, outside of the tanks. More than half of this sum has already been raised.

Fluid Meter Report

PROGRESS reports were presented by four sub-committees of the special research committee on fluid meters. The report of the sub-committee on influence of installation, presented by J. R. Carlton, contained a preliminary draft of the material to be included in the fluid meter report. The principal purpose of this section was to give the prospective user of fluid meters the necessary information to select intelligently the type of meter best suited to his needs.

The report of the sub-committee on description of meters was presented by R. E. Sprenkle, who indicated the method employed by the committee to obtain descriptions and comments from manufacturers. Other reports presented were by the sub-committees on pulsation flow and dimensional analysis.

Lubrication and Anti-Friction Bearings

Under the important subject of lubrication there were papers dealing with the running position of journals and the influence of clearance and length on the friction of journal bearings. Advantages of ball and roller bearings were stressed in a paper that was presented at the iron and steel session.

Friction of Journal Bearings

AN INVESTIGATION at the Bureau of Standards to determine the effects upon the frictional resistance of small-bore full-journal bearings of changes in the length-diameter and clearance-diameter ratios, has resulted in the preparation of this paper for the session on lubrication by S. A. McKee and T. R. McKee, assistant mechanical engineer and research associate, respectively, of the Bureau of Standards.

A journal-bearing friction machine provided a method for measuring the frictional resistance when operating under different conditions of load on the bearing, speed of the journal, and viscosity of the lubricant. By a suitable correlation of these factors a measure of the effects of changes of clearance and length with bearings of the same diameter was obtained. The results indicated that changes in the length-diameter and the clearance-diameter ratios have marked effects upon the frictional characteristics of journal bearings in normal operation. Suitable corrections to a theoretical equation for journal friction were derived from these experiments for bearings of all normal clearances and lengths.

In their conclusion the authors state specifically that the limit of the scope of this investigation was to provide a reasonably accurate experimental indication of the behavior of small-bore full-journal bearings of various clearances and lengths under normal working conditions.

While the results of the tests at the higher values of ZN/P, a viscosity-speed-pressure relation, were fairly consistent with theoretical equations based upon the viscous shear of the lubricant, the authors were of the opinion that it would not be justifiable to predict that these results would give a reliable indication of the characteristics of large bearings operating at high speeds and high loads, since it was reasonable to expect that under

S. A. McKEE

the latter conditions the effects of such factors as journal deflection, distortion caused by uneven heating, and changes in viscosity due to temperature gradients in the oil film would be of considerable magnitude.

Inconsistencies shown by the results at the lower values of ZN/P were an indication that considerable caution should be used if the carrying capacity of a particular bearing was determined by any method based upon the theoretical value of the minimum thickness of the oil film.

Lubrication and Fluid Meters

CAN the journal run with its center above a horizontal line through the center of the bearing, assuming the direction of the load is such that the journal presses vertically downward against the bearing? Is there more than one stable running position for the journal for any one combination of load, speed, viscosity and running clearance? Along what path does the axis of the journal rise from rest to its running position as its speed increase? These were the questions that presented themselves to H. A. S. Howarth, of the Kingsbury Machine Works, when preparing this paper.

Under adverse conditions the author indicated that the journal lift might be greater than generally expected, perhaps of sufficient magnitude to result in rubbing against the cap. The design of the bearing cap therefore became important from this point of view, and it also determined the method of providing and removing the lubricant.

Considerable emphasis was placed by the author on the use of the proper oil for the specific load-speed-clearance combination used. If the oil were not heavy for this combination, the journal life would not be seriously affected. In other words, a bearing that was too lightly loaded for the oil-speed-clearance combination might give trouble by rubbing against the cap. Again, if the speed were too high for the oil-load-clearance combination, similar rubbing might take place.

Anti-Friction Bearings Save Power

ADVANTAGES of ball or roller bearings on almost all types of operating mechanisms were stressed in a paper presented before the Iron and Steel Division by Sidney G. Koon, associate editor of *The Iron Age*. In addition to the savings in power consumption, which frequently ran from 25 to as much as 60 per cent, there also were collateral advantages, as the bearings frequently permitted operations that, without them, would be difficult or expensive.

Limitations to the use of these bearings, particularly those dealing with space limitations on equipment of old design, were taken up, and attention given to the concurrent development of heavy-duty bearings for steel-rolling-mill work along with backed-up types of rolling mills. Many features of operating conditions found in steel mills were discussed in their relation to the use of bearings of this type, and to their care and lubrication.

New Refrigerating Mediums

Two separate treatments of the problem of rail-car refrigeration were presented, one dealing with solid carbon dioxide and the other with Silica Gel.

Silica Gel for Car Refrigeration

AT A JOINT session with the American Society of Refrigerating Engineers, George E. Hulse imparted some interesting information on silica gel. This new medium was a hard, glassy material with the appearance of clear quartz sand. Technically it was pure silicon dioxide, and was chemically inert toward practically all substances. The action of this gel indicated that it was of an extremely porous structure, as it had the property of absorbing large quantities of vapors or liquids. These substances could be removed by activating the gel by heat. This process of absorption and activation could be carried on indefinitely without changing the physical structure of the gel, and consequently the gel could be used as a refrigerating mechanism. Many engineers are seeking information on the adaptability of this material for various refrigerating purposes, so that methods used by the railroads are of interest to other industries.

Details of Equipment

The equipment as applied to a rail car consisted of the absorbers, with the burners and ventilating apparatus in a compartment at the end of the car; the evaporator, suspended just below the car ceiling; the condenser, mounted on the roof of the car at each side of the running board; the float valve on the high-pressure side; check valves between the absorbers and the evaporator and condenser, directing the flow of gas to the proper place during activation and absorption, and the control system to operate the burners at the proper time for activation.

Two Absorbing Units Used

For the purpose of supplying uniform refrigeration the absorbers were divided into two units which operate alternately.

The absorbers, which contained the silica gel were composed of a large number of $\frac{3}{4}$-in. diameter steel tubes. These tubes were in a vertical position, having their lower ends sealed, while their upper ends were welded into headers. Approximately 1,000 lb. of silica gel was contained in these vertical tubes.

A car equipment included two absorbers, each of which was divided into two sections. In all, there were four groups of vertical tubes, each with its main header and a shutoff valve, so that, if desired, any one of these sections could be blanked off from the system.

Below each absorber section was placed a gas burner in the form of an open grid.

The evaporator used was of the flooded type and was suspended just below the ceiling of the insulated car body. It consisted of two sections, each made up of 21 pieces of 2-in. tubing, 16 ft. long, blanked off at one end and welded into a 4-in. diameter header at the other end. These two sections were placed in the car with the headers adjacent and connected together.

Air-Cooled Condenser

The condenser was of the air-cooled type and was carried on the roof of the car. It was made in two sections, each containing 600 ft. of 1-in. plain steel tubing.

The hot sulphur dioxide vapor from the absorber entered these condensing coils at their highest point, at the center of the roof. As the liquid condensed, it flowed to the lower section of the coils, finally draining into the float valve chamber, by means of which it was returned to the evaporator. The float valve used was of the usual construction, placed so that the float was on the high-pressure side. With this arrangement the liquid refrigerant was returned to the vaporator as rapidly as it was condensed and drained from the condenser.

The heating was applied inside the car by means of circulation of hot water through pipes conveniently placed or by the circulation of warm air.

The temperatures obtainable were lower than could be maintained with ice refrigeration, and could be automatically controlled at any desired value.

Fuel Supply Lasts Nine Days

There would be a considerable saving of time in handling these cars en route. The fuel supply would last for nine days under average conditions, and could be replenished in a few minutes. Ice cars required icing at least once a day to keep them operating at the best efficiency, and each icing involved switching with consequent loss of time.

Refrigeration was more easily available at outlying points. Ice cars must have about five tons of ice available at the point where they were to be loaded. At points where few cars were operated this is inconvenient and expensive. These cars could be sent to any point fully fuelled, ready to operate on arrival or after any holdover which might be necessary at the loading point.

Solid Carbon Dioxide

AT THE railroad session in a paper dealing with the use of solid carbon dioxide in refrigerating cars, J. W. Martin, Jr., stated that portable cold could be produced by the use of portable compression and absorption refrigerating systems, but to be commercially practical in such service as is required of refrigerator cars, a completely dependable source of power must be provided. In the absence of such a dependable power source, one was practically limited for mobile refrigeration to stored cooling power.

Solid carbon dioxide prepared by the compression into blocks of the snow formed by rapidly evaporating liquid carbon dioxide, possessed an extraordinarily high latent heat, 276 B.t.u. per lb. in passing from the solid to the gaseous state up to 0 deg. F., and at the same time was endowed with several other extremely important characteristics which made it invaluable as a portable refrigerant.

Of course it was of major importance, he explained, in connection with this new product to know what the possible cost of such a refrigerant would be. At the present time the average price in the United States was a little higher than $100 per ton and even at this price it was finding an acceptance in the ice-cream field and the trucking field, so that last summer approximately 35 tons of solid carbon dioxide had been sold in the eastern portion of the United States. The success that has attended the introduction of this refrigerant had caused a great deal of thought to be given to new methods of manufacture. While it was usually dangerous to attempt to predicate future cost of a product that was coming into public demand, there probably would be found methods to manufacture this product so that it could be furnished for less than $15 per ton.

The natural question that might arise, particularly in view of the bulletins published by the United States Department of Agriculture regarding the effect of solid carbon dioxide upon fruits and vegetables, was whether this refrigerant was perfectly safe for all kinds of lading. It has been found that certain proportions of carbon dioxide gas were beneficial in most cases. However, because this was a new art, definite information on this subject is not available. The present cars were so designed that the carbon dioxide did not enter the interior of the car and did not come in contact with the product.

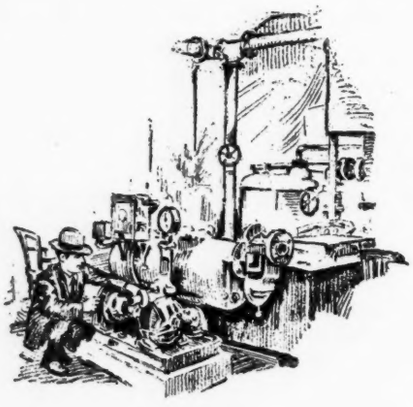
Rambling Thoughts a

WHAT about the Power Show—officially known as the Seventh National Exhibition of Power and Mechanical Engineering? The fair answer is that it was big, impressive and eminently worth while. This statement may not seem to jibe with comments heard on the absence of a number of companies, prominent in the power field, who have been regular exhibitors in previous years. Undeniably, they were not there, and undeniably, they left a gap.

The regular attendant at previous Power Shows found himself in much the same boat as the man accustomed to an annual banquet of seventeen courses, who came one year to find that the *filet-mignon* course had been replaced by an extra serving of caviar. There were still seventeen courses, serially speaking, and still more than he could eat without a stomach ache, but he somehow felt the lack of his *filet mignon.*

Such sentiments were voiced by several Power Show veterans, but all admitted on cross examination that the Show, judged on its own merits, was a great feast for the inquiring engineer and that time spent there was rich in dividends.

Another comment made by some of the visitors was that only a fraction of the equipment exhibited was absolutely new to the field. This is true and always must be if manufacturers are not to bankrupt themselves by continual changes of models. In the matter of new equipment, as in all things, there is a golden mean between stagnation and a runaway. The exhibits at the Show were ample evidence that the power-equipment industry



is thoroughly alive, but determined to subordinate change to the possibility and practicability of substantial improvements in design. The fact remains, as far as the Power Show is concerned, that no man living can absorb this year or hope to carry over to the next a complete mental picture of all the equipment shown. The periodic review of existing equipment is a necessity if one is to retain what he has learned of equipment. New equipment discovered is just so much velvet.

Now what can the writer do for the reader who was unable to attend this year's Show? He cannot bore him

with endless pages of detailed descriptions of what was seen in the 540-odd booths by the thousands who milled through four floors of the Grand Central Palace, New York, during the week ending Dec. 8. Nor could the paper mill stand the strain. He *could* tell the reader the details of the new apparatus shown, but that will be done better week by week, and in a special review issue later on, by the editor of "What's New in Plant Equipment."

The reader is best served here, the writer feels, by a symposium of random impressions or rambling thoughts at the Show: What skilled observers saw; trains of thought on power developments and trends inspired by trips through the Show; significant incidents and bits of conversation.

One man tackled was C. Harold Berry, formerly associate editor of *Power* and now the successor to Harvey N. Davis as professor of mechanical engineering at Harvard. Mr. Berry had this to say:

"A cursory trip through the Power Show gave me a feeling of regret that the power equipment is so heavily diluted with other things. To be sure, the engineer is concerned with many things that have nothing to do with power, and perhaps there is real value in showing him material that is normally outside his line of interest and knowledge, but nevertheless it seems too bad that so much space is given over to things whose connection with engineering is so remotely marginal.

"However, the Show is by no means lacking in excellent exhibits of power-generating and using equipment. There are some interesting water-wall and refractory booths, and instruments for plant and laboratory are well presented, with the exception of a few well-known firms whose absence is noticeable. In combustion equipment there seems to be little beyond small stokers and house-heating equipment.

"The absence of many old exhibitors whom the visitor has learned to look for is doubtless a protest against the multiplication of shows in recent years, and it cannot be denied that the manufacturer's burden is heavy. But, on the other hand, repeated showing of one's product is not entirely a duplication of effort and expense, for, while the product may not change, the audience does change. Many of the same men come year after year, but each year their problems and interests are different.

ts at the Power Show

And often an exhibit that has been passed with a glance in previous shows will command the closest attention on another occasion. I therefore hope future shows will come back to the distinctly power field."

Then there was Col. Peter Junkersfeld, president and general manager of McClellan & Junkersfeld, Inc. At the request of the editor, Colonel Junkersfeld did not confine himself to things actually seen at the show, but added his comments on trends out of a long experience in the power field.

"The Seventh Annual Power Show," said Colonel Junkersfeld, "may not include many spectacular advances in individual equipment, apparatus or material, but it does indicate a substantial advance in the general average quality of the exhibits. This may be the result of experienced and convincing demand for better and more suitable products or of initiative in design and manufacture, or, as is usually the case, of both to some extent. In any event, the Power Show indicates progress made in individual equipment and affords opportunity for the designers and operators of power plants to continue the downward trend in the cost of dependable power.

"The burning of coal in pulverized form, for example, a subject much discussed as of doubtful advantage only a few years ago, has found rapidly increasing application and fewer and fewer conditions where it cannot be employed advantageously in large plants. The unit system as contrasted to the storage system is being used to an increasingly larger extent for many conditions.

"There are some instances where boilers that have been in service a few years have been and are being equipped with water walls or equivalent, larger air-supply and mechanical-draft facilities and generating equipment replaced with larger and more economical steam turbine-generators and condensing equipment, with the result that the complete unit delivers approximately twice as much electrical energy as when the boilers were originally installed. There are many new installations under way where similar large increases in final output per unit of boiler heating surface and in cubic feet of building space are being or are about to be realized.

"The turbine-generators fall into three general classes: (1) Single-shaft units for moderate-capacity new stations and replacements of units in existing stations; (2) single-shaft units of capacities in the order of 150,000 kw.; and (3) group units of extra large capacity containing two or three separate turbine-generator elements, frequently on as many different shafts. Most of these have attained on the whole constantly improved economy in construction and operation, but some are still subject to 'growing pains' as evidenced by occasional outbreaks of trouble in some one group and then in another group of machines, or of auxiliary equipment. However, even these troubles seem to be at longer and longer intervals and of lesser average extent, and seem to be in some measure an almost inevitable accompaniment to energetic advancement in design and construction of plant, in design and manufacture of equipment, and in the extent and rapidity to which higher peripheral speeds, higher pressures and higher steam temperatures are used.

"The pressures used in new stations are in three groups: (1) Those from about 300 to 450 lb.; (2) those between 550 and about 800 lb.; and (3) those in which the pressures under (1) have smaller units superimposed in the steam cycle at pressures of 1,200 lb. or more. The total temperatures have been and are still being increased, and a number of installations are now operating at about 750 deg. F. with increasingly satisfactory results.

"These pressures and temperatures require that steam-driven auxiliaries, piping and heat-balance accessories be suitable for such conditions. They are to be seen in many creditable exhibits that indicate much painstaking effort to design and produce apparatus and material in keeping with the increasingly stringent requirements. This is also true of economizers, air preheaters and ash removal, and of the many mechanical and electrical accessories, most of which show improvements, especially during, say, the last few years.

"Piping, valves and fittings, instruments and recorders of various kinds, combustion controls and furnace details are only a few of those that have been and are still receiving much attention in their further development, as evidenced in many of the exhibits.

"Power-utilization apparatus to reduce manufacturing and installation cost and improve output is receiving much attention, and is probably the most promising and fruitful field of further endeavors in maintaining and enlarging the industrial and commercial position of our country. The evidence of the amount and character of such betterment under way is gratifying.

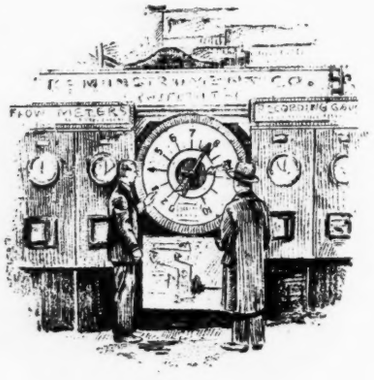
"Among others, there are three questions that are always in order when reviewing any individual apparatus or related equipment for power generation or for power utilization:

"1. To what extent will the performance of the plant be improved in economy, reliability or otherwise?

"2. What actual or possible offsets or objections to the equipment?

"3. Are the net benefits to the plant as a whole and to the service it renders sufficient to justify the installation in a proper and complete comparison with other available equipment?

"The final answer," Colonel Junkersfeld concluded, "must be one of unbiased judgment based on competent experience in obtaining and analyzing the pertinent facts and their proper application to the equipment under consideration and the probable net effect on the financial outcome and on the service rendered to the public."



Colonel Junkersfeld's thoughts naturally ran to combustion and steam power. Just as naturally did F. A. Annett, associate editor of *Power*, interpret and project the show in the terms of his keen interest in matters pertaining to electricity, automatic control systems and mechanical power transmission. His comments follow:

"One cannot view the Power Show without being impressed with the almost unlimited number of ways in which electricity serves industry. In practically every booth all or some part of the exhibit involved electrical operations. These included complete systems of automatic combustion control, for regulating all operations in the boiler plant in accordance with load demands.

"For the electric power system, supervisory control was demonstrated. This system allows controlling all the operations of the power system from a central point and obtaining an indication of the operations. As the equipment is usually constructed, 90 operations can be obtained over four wires, but it is possible to construct the system to perform 253 operations over the four wires. These operations may be opening or closing of circuit breakers, taking meter readings, connecting and disconnecting machines, or any other functions necessary to the control of machines and circuits.

"An outstanding feature of the electric power equipment was the evidence of revolutionary changes in the design of motors and controllers to make them more complete and applicable to driving machines. Simplification appears to be the watchword among the manufacturers. By better designs, improved methods of ventilation and the use of anti-friction bearings, the overall dimensions of motors have been materially reduced.

"In alternating-current practice, by the use of improved types of rotor windings, squirrel-cage motors up to 30-hp. capacity can be connected directly to the line at starting. This has greatly simplified the starting equipment for this class of motor. Instead of a large combination oil switch and auto-transformer for applying reduced voltage to the old-type motors, a simple magnetic contactor or circuit breaker is all that is required for the new design. This contactor probably does not weigh more than one-tenth as much as the reduced-voltage compensators and the relative space requirements are in about the same proportion. Furthermore, the magnetic contactor lends itself readily to any form of protection and to remote control.

"The automatic magnetic contactor replacing the old compensator is typical of the whole field of power applications. Everything is being made automatic or remotely controlled. Remotely controlled circuit breakers for motor starting or the control of other circuits, circuit breakers that, in case of power failure on one source, will automatically throw over to another supply. When the original source is restored, the breaker will automatically connect the load to it. These and many others were indications pointed toward the reduction of the human element in the operation of power equipment.

"Another indication of how completely electric transmission and control has permeated practically every function of industry was the presence of systems for giving long distance readings of temperature, pressure and other operations. With the old methods the distances over which readings could be transmitted were limited to a few feet. With electricity, space has been almost eliminated.

"In many of the devices used to measure fluids the old mechanical methods have been replaced by electrical means. Valves that at one time were operated entirely by manual effort are now remotely controlled automatically by electrical means. This feature stood out very clearly at the Show.

"Mechanical variable-speed transmissions that used to be manually operated have been made completely automatic by incorporating electric control in them. A small electric motor and control adjusts the speed according to the requirements of the process. The electric application is carried a step farther in this device, an electric tachometer indicating the speed that is being maintained.

Mechanical Transmission Stages a Comeback

"At one time the idea was prevalent that mechanical power-transmission equipment was going to pass out of the picture and would be replaced by the direct-connected motor. A reaction set in, pointing in that direction, but the situation has been changed and engineers are finding that these devices have a wide field of application based on sound economic considerations. The many exhibits of belts, both of the standard and patented type, chain drives, gear-type speed reducers, clutches, variable-speed transmissions, shafting and hangers and other devices of this class, clearly indicated the large interest this equipment has in the power application field.

"One exhibit of a speed changer, combined with a motor, was significant of the trend toward more compact power units. This combination unit occupied very little more space than was formerly required by the motor alone. The speed reducer allowed designing the motor for the most economical speed and at the same time gave the desired speed at the coupling connected to the driven machine."

L. H. Morrison, who handles oil engines for *Power*, did not find so much material at the Show to work on, but nevertheless had a thought or two well worth the careful consideration of manufacturers and power engineers.

"With the exception of one exhibit," Mr. Morrison pointed out, "the internal-combustion engine is missed from the Show. There seems to be a complex among manufacturers, leading them to believe that the Power Show deals exclusively with steam equipment. The total value of internal-combustion engines and accessories sold for power-generation purposes is over half the total value of all steam-plant equipment sales, but the builders of oil and gas engines are failing to impress this fact upon the buying public. If several manufacturers of units light enough to be moved into the building, had exhibited a number of applications of these units, an immense interest would have been aroused.

Gasoline Engines for Power Plants

"The gasoline engine is being used for breakdown service in many steam plants, thereby eliminating much of the otherwise needed stand-by boiler and engine equipment. Others are used in municipal pumping plants where motor-driven pumps are the main units, for the gas-engine stand-by set permits a reduction in the town's fire-insurance rate. Typical sets of this kind would have drawn the crowds. Oil engines driving power shovels and similar machines would have helped to bring the internal-combustion engine into prominence."

A. L. Cole, of *Power's* staff, who follows equipment trends closely, submitted the following after making the rounds of the Show:

"Although the total number of exhibitors was greater than heretofore, to the visitors interested especially in major combustion and steam-generating apparatus the Show fell somewhat short of previous years. Space usually occupied by these larger manufacturers was taken up by miscellaneous equipment more or less outside the power field. This was also true of the piping and high-pressure valve divisions and was reflected to some extent in the combustion-control and power-plant-instrument sections. Individually, the exhibits were probably more complete and more attractively arranged than in former years.

"In the showing of new equipment not heretofore presented to the public, the exposition compared favorably with other years, the apparatus and devices shown covering rather a broad field."

Such observations and musings as these are natural products of the Power Show, as is also a certain pictorial grasp of the field not easily conveyed in words. But every show has byproducts as well as products, and the byproducts may be the more important, as often happens in industry itself. One hears a lot of talk about byproduct power—and it is something worth talking about—but engineers sometimes forget that thought itself may be a byproduct. When the byproduct thought happens to impinge on the subject of byproduct power, things are likely to start moving, as was nicely illustrated by a little incident at the Show.

A cost-finding expert and a power engineer, both of whom must remain anonymous, met, and their chance meeting bids fair to save a certain industrial plant something like $50,000 annually.

Here is the story in a nutshell. The accountant sought information on proper methods of distributing charges for steam and power supplied to manufacturing departments. This led around to the discussion of a large process plant under investigation by the accountant. The set up is this roughly: 24-hour power and process loads, both practically constant; 1,200 kw. generated by condensing turbine; 40,000 lb. of steam per hour supplied direct to process from the boilers; boiler pressure 150 lb., but capable of being raised to 200 lb. with existing boilers; process pressure 100 lb., capable of being reduced to 40 lb. without affecting production.

Easy picking for the power engineer! He unlimbered his pencil and soon proved that all the power used could be produced as a byproduct of process steam by raising initial pressure, lowering process pressure and installing non-condensing turbines. After allowing for overhead on the new turbine, this left a clear saving, as already indicated, of about $50,000 yearly.

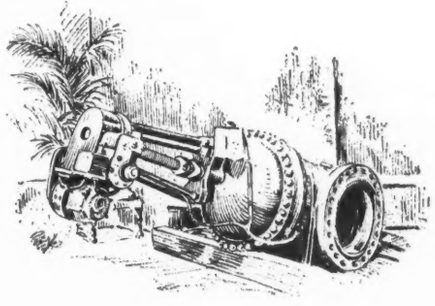
It is significant that, after several years of drumming in, the importance of byproduct power is just beginning to sink into the consciousness of many owners. Annual savings totaling many millions are waiting to be picked by those who know a good thing when they see it.

It must be laid to the credit of the accountant that he had already sensed the possibility of a large saving, but it took this impact with a power engineer to strike the spark which set off a long train of beneficial results reaching all the way to stockholders and ultimate consumers.

So much for money and mechanism, for whether engineers will admit it or not, there is something more than mechanism and money to a Power Show. Consciously or unconsciously, beauty creeps in, and the average engineer does appreciate beauty.

The writer does not mean what the reader thinks he means. He has in mind particularly the better eye for suitable paints on machines and for the arrangement of apparatus in booths. Not only that, but the greater taste shown in the designs of the machines themselves. Beauty of proportion is generally taken as some measure of the engineering skill of the designer. There seems to be a basis of truth for this feeling. At any rate, even if this idea should prove to be nothing but a superstition it has at least made this world of machines a better place to live in.

Strange errands find their way into a Power Show. A comely woman, apparently not one interested in machines for their own sake, sought the Show to stalk some unknown firm, which, she claimed, had infringed patents bequeathed to her by her husband. She had only vague clues, nor did she expect that the company sought would exhibit at the Show. However, she felt that by interviewing makers of similar equipment she might eventually find the path to the pot of gold at the end of the patent rainbow. The writer knows nothing of the merits of her case or the success or failure of her search, but the incident interested him because it was typical of hundreds of other incidents, not announced on the programs, that give the touch of human interest to great expositions such as this.



Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Practical Location and Drive for the Chemical Pump

WHERE a chemical-type water softener is used, a pump or some other means of feeding the chemicals into the softener in direct proportion to the water being drawn from it must be used.

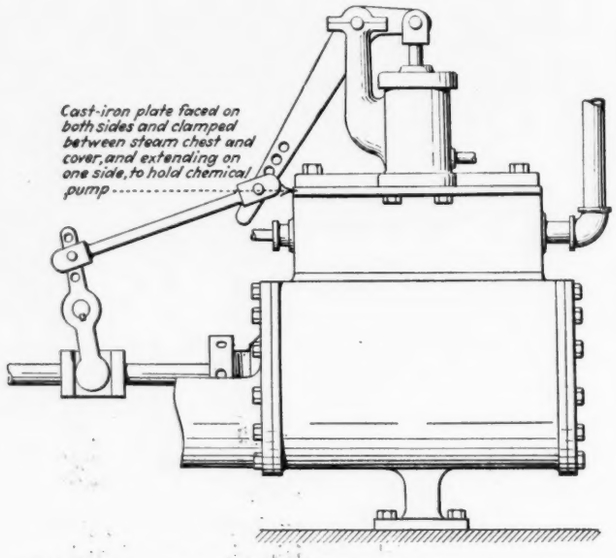
This is usually accomplished by attaching the driving arm of a small single-cylinder plunger pump to some moving part of the boiler-feed pump.

In laying out such an installation, it is sometimes a problem to find a place to set this small pump, where it will be out of the way and still line up with the feed pump, its source of power.

In one case a cast-iron plate was faced on both sides and drilled so as to clamp between the steam chest and the cover plate on the boiler-feed pump, as shown in the accompanying sketch. Then the chemical pump was bolted to this plate, which was made to project on one side of the steam chest.

In order to do this, the studs holding the cover plate had to be removed and longer ones put in. Also a gasket had to be made to go between the plate and the cover plate and one to go between the plate and the steam chest.

One of the valve-actuating arms of the boiler-feed


Cast-iron plate faced on both sides and clamped between steam chest and cover, and extending on one side, to hold chemical pump

Chemical pump held by plate clamped between steam chest and cover

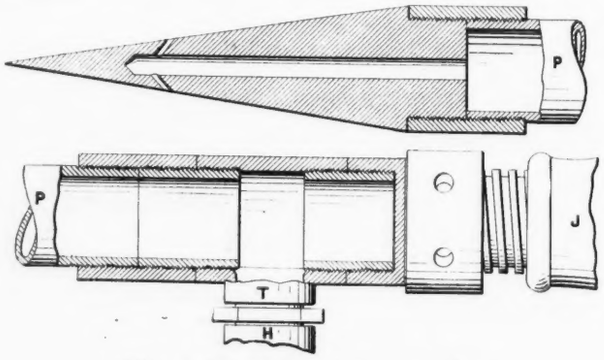
pump was removed and a new one made, with an extension on the top end, to which the driving link to the chemical pump was attached as shown.

It may seem strange that the plate was not put on top of the steam-chest cover, but the cover was rough on top and would have had to be faced off, and the plate was not strong enough to act as the steam-chest cover.

Coffeyville, Kan. P. A. GETT.

Practical Type of Pipe Point with Water Circulation

IT WAS necessary for us to get a four-wire circuit across the street in front of our plant and across a railroad right of way. The circuit could not be carried overhead, and owing to heavy traffic on the street it was impracticable to open the street and lay the conduit, so



Pipe point with water connection

we tried the expedient of driving the pipe under the street.

At first we used wooden and lead mauls. This resulted in breaking the pipe at the joints. We then drilled our home-made drive point and connected water to it through the pipe *P* and hose *H* as shown in the illustration. The pipe threads were cut so that the pipe and nipple ends butted. A screw jack *J* was then used to push the pipe, five-foot lengths of pipe being used. The street had been paved with gravel originally and the level raised from time to time. We jacked the pipe through the gravel, and the water never failed to loosen up in a few minutes obstructions that stopped progress. The total width of the street was 60 ft. and the point did not run more than six inches out of line. There was much less trouble in going under the railroad, although the distance in that case was about 100 feet.

Elgin, Ill. W. L. PARKER.

Causes of No-Voltage Coil Overheating

A SOLENOID coil on the no-voltage release of an alternating-current motor starter burned out. This was replaced by a second coil which also burned out after a short time. A third coil was fitted, but when connected to the line, it also overheated and an investigation was started to find the cause of the heating.

The coil and trip gear were dismantled, and it was found that the movable iron core was attached to a thin brass stem on which there was a spiral spring. This spring performed no useful duty but evidently had been inserted after the starter was put into service. The spring acted as a short-circuited secondary to the coil and had a current induced in it similar to the secondary

circuit of a standard alternating-current transformer.

In an alternating-current coil the current is limited by the ohmic resistance and the induced voltage in the coil. The induced voltage in the coil is determined by the magnetic field in the coil and the frequency of the current. The current flowing in a secondary coil is in opposition to the primary current and tends to weaken the magnetic field and decrease the induced volts in the primary coil. As a result the current increases in the primary coil. This is one of the explanations for the heating of the no-voltage release coil. The current flowing in the spring caused the current in the solenoid coil to increase.

The spring also prevented the core from pulling all the way up in the coil. This increased the air gap in the magnetic circuit, which caused a decrease in the magnetic field and of the induced voltage in the coil. As a consequence of this the current was increased in the no-voltage release coil. The combination of these two effects increases the current sufficiently to burn out the coil.

The starter referred to was a fairly old one, and the spring may have been inserted by some maintenance man to insure a good fit. The spring was removed and the space between the core and the brass spindle was packed with a leather washer, after which the coil was found to run quite cool.

When the coil on an alternating-current magnet is first connected to the line, the inrush current is several times greater than when the magnet core is in the closed position. For this reason it is necessary that the magnet core closes when the coil is energized, or the coil will roast out. When trouble is experienced with an alternating-current magnet coil burning out, one of the first things to check is the operation of the magnet, to make sure that it closes properly.

A short circuit in the coil of an alternating-current magnet has a double effect. First, it reduces the ohmic resistance of the coil, and second, the induced voltage is decreased by the reduced number of turns and by the short-circuited section of the coil acting as a closed secondary winding. As a result, the short circuit of a small number of turns may cause a large increase of current in the coil and roast it out. W. E. WARNER.

Brantford, England.

How Leaky Gage Cocks Were Avoided When Using Soda in the Boiler

DURING the last year it was found that the use of soda was desirable to maintain certain conditions in the water in the boilers of our plant. With the use of the soda, however, it was noticed that the leakage of the gage cocks was more common, for before we began using the soda we had no difficulty in keeping them tight.

A remedy was found, which is so simple that it was not thought of for some time; but having tried it I feel perhaps some others might not have thought of it.

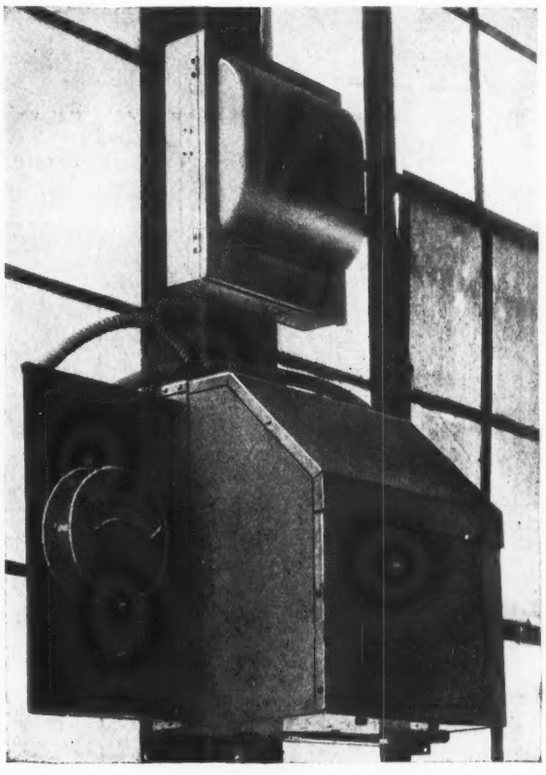
It was the custom for the fireman to blow down the water column and then try the gage cocks at the beginning of each watch. This was done each time in the order mentioned. As the soda in the water was the cause of the leakage, the gage cocks were tried first, when there was only distilled water in the water column with no soda in it, and afterward the water column was blown down. This remedied the trouble.

Boston, Mass. M. W. EASTMAN.

Ammeter a Useful Device for Checking Loads

ELECTRIC meters may be used for various purposes to improve industrial plant operation. They may be of either the indicating or recording type. An ordinary switchboard-type ammeter mounted on a small panel will be found useful for checking loads and giving the operator an idea of how any particular machine is being handled.

The figure shows a direct-current ammeter arranged for easy mounting and connecting to motor circuits in one plant. This meter is not intended to replace the recording wattmeter, which is practically indispensable if a plant is to be operated efficiently. For many purposes, where a record of the power input is not necessary, the ammeter serves nicely.



Ammeter mounted on a panel for easy connecting into motor circuits

If a machine is overloaded, the ammeter will show this, in most cases, just as conclusively as a recording meter. Where machine operators are to be instructed in the proper handling of machines, the ammeter gives an indication that is more readily understood by the operator than is a graphic reading. After the operator has been instructed, the ammeter can be left in the circuit for a period so that the operator may see the effects of any changes in machine operation and thereby become familiar with what is best practice for any particular installation or machine.

The expense may not justify an ammeter on each motor, but one meter arranged so that it can be readily used on machines about which there may be doubts of how they are operating, will be found a good investment. J. A. STORMS, Mechanical Manager,

Hillburn, N. Y. Ramapo Ajax Company.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

DeWolf Air-Cooled Furnace Wall Construction

IN THE air-cooled furnace wall construction illustrated, designed by Roger D. DeWolf, Rochester, N. Y., the steel structure which supports the wall and the refractories is designed to be flexible and resilient rather than rigid and monolithic.

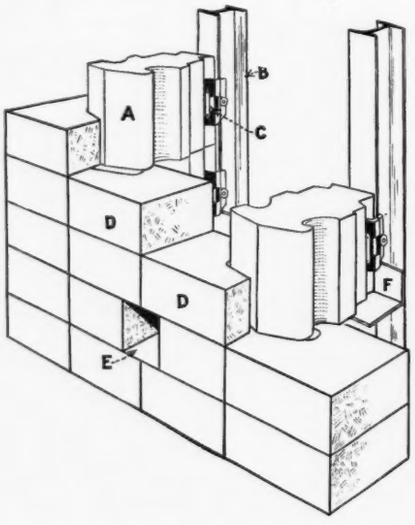


Fig. 1 — Method of supporting wall by hanger bricks suspended from I-beams

Standard 4- or 6-in. I-beams are used for the supporting structure, and the design of the wall allows these beams to be readily spaced to permit location of access or ash doors, soot-blower heads, pulverized-fuel burners, etc., and also the attaching of these doors or burners rigidly to the supporting columns independent of the refractory.

Another important feature of the wall is the provision made for supporting the wall in horizontal sections of 32 or 40 in. widths, to facilitate repairs of any section without disturbing the section above or below it.

Fig. 1 shows the general construction of the wall. The hanger brick *A* is secured to the supporting column *B* by means of a clamp *C*. This clamp is protected from the high temperatures by being exposed to the air on all sides. The hanger brick *A* holds four face bricks *D* and the design of the joint is such as to give a certain amount of resiliency between the two. The clamp *C* is also designed to permit a slight movement of the hanger brick *A* with reference to the I-beams. The flexibility provided at these two points permits the wall to expand and contract with the changes in temperature, without setting up mechanical strains in the bricks themselves, which tends to cause fractures and spawling.

To support the wall in horizontal sections, angle pieces *F* or continuous angles are riveted to the I-beams at points vertically 32 or 40 in. apart, as may be desired. The opening shown at *E*, Fig. 1, is 4 in. square, and it will be apparent that by using different I-beam spacings and different widths of brick, the design readily adapts itself to different boiler and furnace dimensions, and practically any size of opening required is readily obtained.

Fig. 2 shows a furnace in which the front and side walls and the horizontal part of the arch are completed, and the rounded portion of the arch under construction. This view shows continuous angles being used for supporting the hanger brick above the arch, and the use of angle sections on the side wall supporting beams for the same purpose.

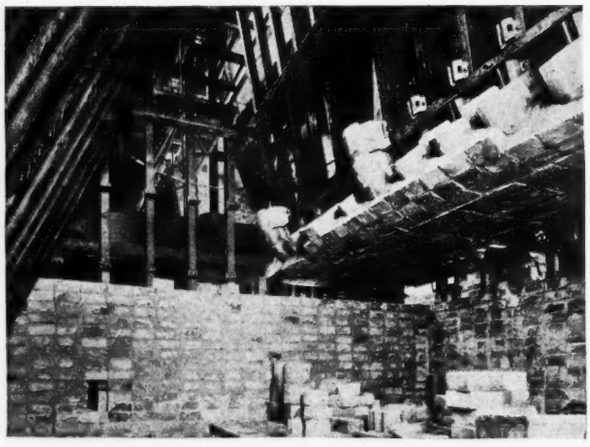


Fig. 2 (Left)— View of side and front walls and arch under construction

Fig. 4 (Below) —Wall is adaptable to use of water-wall tubes and multiple burner and air openings

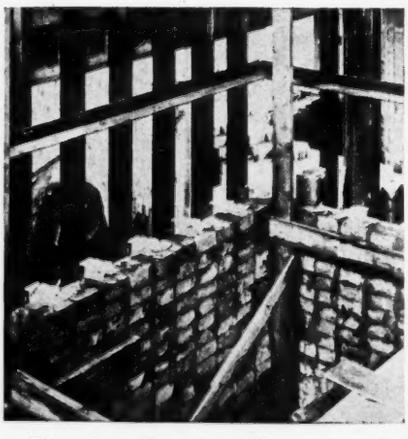


Fig. 3 (Above) — Hanger and face brick are free to expand independently of each other, joints between face bricks only being sealed

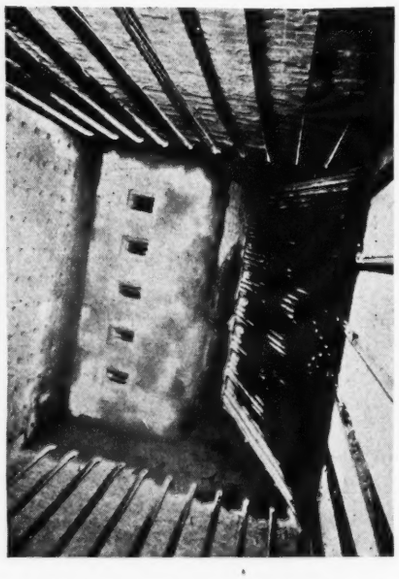


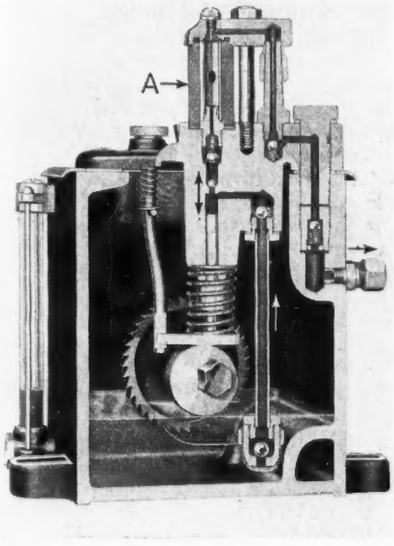
Fig. 3 shows the top view of a wall under construction, and also shows the joint between the face bricks *D*

sealed with fireclay mortar but with the joint between the hanger brick *A* and the face bricks *D* left free to permit the wall to expand and contract freely. Another feature of the wall is the adaptability for use with water-wall tubes, the water tubes being located on the inner surface of the wall with the ends extending out through the walls for connection to headers, as shown in Fig. 4. This view also shows burner openings through the arch and secondary air openings in the front wall.

The wall is inclosed on the outside by a covered plate of transite or other suitable material bolted to the flange of the I-beams, thus forming the vertical air duct through which the air for combustion is circulated. The wall is manufactured by the DeWolf Furnace Corporation, 119 Main St. East, Rochester, N. Y.

Model "F" Force-Feed Lubricator for Diesel Engines and Air Compressors

IN THE Nov. 6 issue the model "F" force-feed lubricator put out by the American Oil Pump & Tank Company, Cincinnati, Ohio, was



Cut-away view of lubricator

illustrated and described. The model "K" lubricator, similar in many respects to the model "F" and designed for the timed lubrication of Diesel engine cylinders, air compressors and similar equipment, is illustrated herewith.

The operating parts of the pump are essentially the same as the model "F" with the exception that one plunger is used per unit instead of two. By referring to the cut-away view, the principle of operation of the pump will be readily understood. The plunger is operated by a cam driven by means of a ratchet and pawl or positive drive, as best suits the service on which the pump is to be used. The oil is drawn into the cylinder and discharged through the valve and sight-glass, as indicated by the arrows. The sight-glass is filled with glycerin and the movement of the lubricating oil through it can be observed at all times.

When applied to Diesel engines, the lubricator is driven from the lay-shaft of the engine by means of a chain and sprocket or by a set of gears, and can be adjusted so that the plungers operate in synchronism with the engine piston, the oil being delivered to the piston at the end of the power stroke.

After the timing requirement of the engine is known, the cams are placed on the driveshaft of the pump in various positions so as to bring the end of the plunger stroke on each unit to correspond with the position of the piston to be lubricated. The oil discharge will then synchronize with the firing of the engine. On large engines requiring the injection of oil at several points in each cylinder, multiple-feed lubricators are used with the required number of feeds for each cylinder, arranged to operate simultaneously.

The lubricators are also particularly adaptable for air-compressor lubrication, and where the air and power cylinders operate under totally different conditions, requiring different grades of oil, the lubricator is furnished, when desired, with two compartments, the larger containing the units for lubricating the power cylinders and the smaller those for the air cylinders.

It is pointed out by the manufacturer that the model "K" unit offers a wide range in feed regulation. It can be set to feed a minimum of one drop every eight strokes of the plunger or a maximum of twelve drops to one stroke of the plunger. Like the model "F," previously described, the model "K" has one pumping unit for each feed, which is entirely separate and removable from the reservoir without disturbing any other unit. Lubricators of from one to sixteen feeds are available, and units with more than sixteen feeds can be furnished.

Helmet Goggles for Cutting and Welding

ACCESSORIES for welding and cutting recently added to the line of the Oxweld Acetylene Company, 30 East 42nd St., New York

Cap- and skeleton-type helmet goggles

City, are the cap- and skeleton-type helmet goggles shown in the accompanying illustration.

The No. 9 cap-type goggles consist essentially of a strong fiber cap to which a pair of goggles are attached by means of fiber links. The goggles can be readily raised over the forehead or lowered over the eyes with one hand. The bridge is adjustable and is covered with rubber insulation. Replaceable lenses in the same size and colors that are supplied in the No. 6 goggles made by this company are used, the colored lenses being protected by cover lenses of clear glass. The No. 10 skeleton-type goggles are the same except that the goggles are attached to a lattice skeleton cap. Both styles are provided with leather straps at the rear for head-size adjustment.

Farval Lubricating System

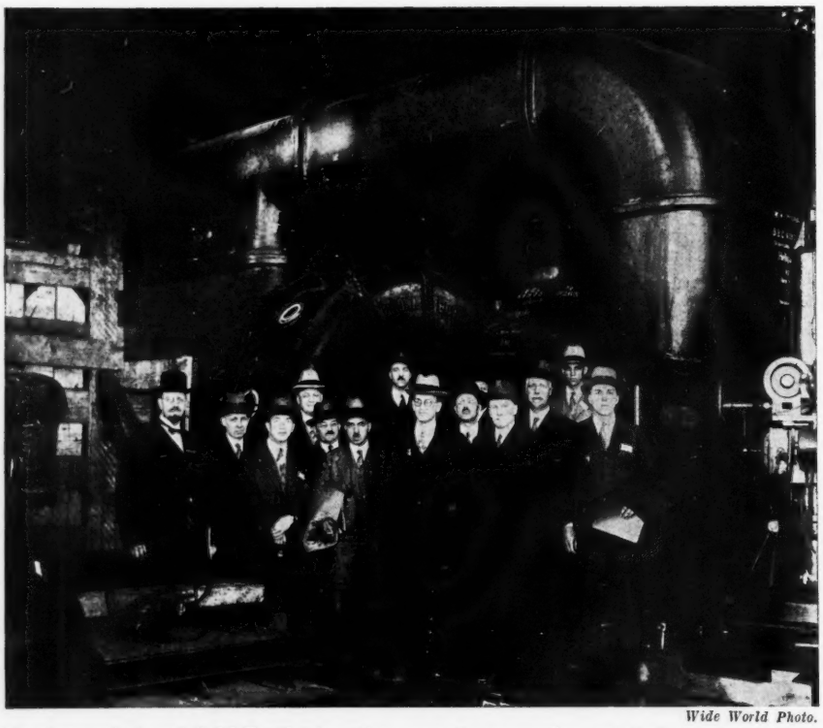
THE "Farval" mechanical lubricating system, formerly known as the "Farmer" lubricating system, has been acquired from the Farmer Lubrication Systems, Inc., 2611 Sixteenth St., Detroit, Mich., by Lubrication Devices Incorporated, 51 South Washing Ave., Battle Creek, Mich.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING

INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

A. S. M. E. Visits Hell Gate Station



Wide World Photo.

Members of the A.S.M.E., during the annual convention, visited the Hell Gate Station of the United Electric Light & Power Company in New York City. A group is shown here standing near the 160,000-kw. American Brown-Boveri turbine which will soon become the world's largest unit in operation

Boulder Dam Engineering Board Reports Project Feasible

Sets cost $40,000,000 higher than estimate—President Coolidge suggests favorable Congressional action

IN A report covering the engineering and economic factors involved in the Boulder Dam irrigation and power project, proposed for the Colorado River, the special board of engineers appointed by the Secretary of the Interior, has just returned favorable recommendations. Setting the original estimate of $125,000,000 at something like $40,000,000 too low, the board points out that increased factors of safety and additional provision for water diversion during the construction of the dam will be necessary in order to remove undue risk from the undertaking. At the same time, the study made by the board indicates that the Black Canyon site will be a more favorable location for the dam than Boulder Canyon.

A quick glance at the report yields the following points of interest:

The Colorado River

One of the largest in the country, the river drains an area of about 244,000 square miles and in a length of 1,700 miles drops more than 7,500 ft. Because the average rainfall in this drainage area is only 10 in. per annum, the river flow in full normal flood is less than 200,000 sec.-ft., although the board anticipates a possible maximum of 500,000 sec.-ft. (Compare this with the Susquehanna, which drains an area of about 27,000 square miles, yet is provided with facilities at Conowingo, Md., for handling 880,000 sec.-ft.)

Comparison of Sites

Findings of the board's geologists indicate that the Black Canyon site "is more accessible, the canyon is narrower, the gorge is shallower below water level, the walls are steeper, and a dam of the same height there would cost less and have somewhat greater reservoir capacity." A better grade of rock for foundations is also found at Black Canyon, as well as a more favorable site for establishing a construction camp, gravel pit and terminal railroad facilities. The danger of earthquakes of sufficient violence to threaten a properly constructed dam is considered negligible.

Proposed Dam

By far the highest in the world, the Black Canyon dam would have a crest height above low water of 550 ft., and would impound a lake containing 26,000,000 acre-feet of water. Some idea of the responsibility resting on the constructors of the dam is given by this statement in the report: "If the dam should fail, the flood created would probably destroy the cities of Needles, Topock, Parker, Blythe and Yuma, and permanently destroy the levees of the Imperial district, creating a channel into Salton Sea which would probably be so deep that it would be impracticable to re-establish the river in its normal course. To avoid such possibilities the dam should be constructed on conservative if not ultra-conservative lines." Stresses in excess of 30 tons per sq.ft. could not be considered conservative in a structure of such unprecedented magnitude, the report concludes, and points out that the use of these comparatively low pressures considerably affects the estimated cost.

The board investigated at some length the possible methods of construction of the dam. In brief the plan calls for the building of two cofferdams, one 70 ft. and the other 29 ft. above low-water level. These dams, constructed of earth and boulders excavated near the site, would provide a dry area in the river bed at the point where the dam would be constructed. The river flow would be diverted through three tunnels 35 ft. in diameter bored in the canyon wall bypassing the dam site, and capable of handling 200,000 sec.-ft. between them. This feature represents a considerable increase in capacity over the original plan, which the board felt was necessary to protect the lower valley in case the cofferdams gave way.

Power and Irrigation

The power plant, which would be an item of secondary importance in the project, would nevertheless have to carry the burden of the amortization of the funds invested, according to the original plan. The board finds that, owing to the variable flow of the river, a maximum installation of 1,000,000 hp. would

be called for and under present conditions of irrigation 550,000 hp. could be continuously generated. Nothing untoward is found in the construction of such a plant, and it is said that it would contain largely standard equipment.

The main feature of the project is, of course, flood control and the provision of a steady flow of water for irrigation. One of the main proposals is the construction of an all-American canal approximately 75 miles long to divert water into the Imperial Valley. A side canal to the Coachella Valley is also included in the undertaking.

Estimates of Cost

The board finds that the original figure of $125,000,000 will not cover the project if the recommended safety factors are adhered to. It estimates the costs as follows:

Dam and reservoir.....	$70,600,000
1,000,000-hp. development..	38,200,000
All-American canal	38,500,000
Interest during construction	17,700,000
Total	$165,000,000

to which would be added $11,000,000 if the Coachella Canal became part of the main project, bringing the total to $176,000,000.

The President's Comments

In his message to Congress President Coolidge comments favorably on the report of the board, remarking that "their conclusions appear sufficiently favorable so that I feel warranted in recommending a measure which will protect the rights of the states, discharge the necessary government functions, and leave the electrical field to private enterprise." In view of this statement and the general interest shown in Congressional circles, it is likely that prompt action of some kind will be taken in this session of Congress.

Jet Dispersers for High-Head Indian Plant

A notable instance of the improvement that has recently been made in the details of hydro-electric power plant is the method of harmlessly dispersing the energy released in the escaping water jets from high-head turbines. Recently, a set of ten 12-in. Glenfield jet dispersers was supplied to a large Indian power station which operates at 1,500 ft. head and discharges vertically downward to the tailrace below.

If the water were exhausted as an ordinary "solid" jet, the result would be devastating. With the jet disperser, however, the water discharges harmlessly into the tailrace and, when the 12-in. valves are fully open, constitutes an impressive spectacle similar to the blowing off of steam at very high pressure. In the device the escaping solid stream of water is given a tangential motion, so that it bursts into myriads of drops, which are spread over a comparatively large area, each drop being cushioned against the air resistance so that its energy is dissipated separately and harmlessly.

Chicago World's Fair Committee Chosen

Rufus C. Dawes, president of the Chicago World's Fair, 1932, has just announced the personnel of the National Research Council's co-operating committee, which will assist the officials of the fair in developing the scientific theme of the city's centennial celebration. The committee will consist of Dr. Frank B. Jewett, chairman; Gano Dunn, Dr. Michael I. Pupin, Dr. Max Mason, Dr. William A. Pusey, Dr. Simon Flexner and Dr. Vernon Kellogg.

"We have asked the council to help us," said Mr. Dawes, "not only to make an adequate statement of what might be called the philosophy of our exposition, but, in addition, to have that statement endorsed by competent authorities. We need help in the practical development of this theme into a series of classifications. We must be able to present, in an intelligent and convincing manner, the benefits and advantages to be derived from our plans by the various associations of industries and other groups, and we need help in selecting the men who will be recognized as competent to deal with our general theme in detail. We have the assurance of this body, through Mr. Kellogg, that it will be pleased to co-operate in any way possible and feasible to them to contribute to the success of our celebration."

Black River Development in Progress

Construction of the power development of the Montreal Island Power Company on the Riviere des Prairies at Black River, is now in full swing. The installation will consist of ten units of 12,000 hp. maximum capacity, with a total of 90,000 hp. under normal conditions. The generators will be spaced evenly down a 700-ft. building on 62½-ft. centers. The head of water will vary from 18 to 26 ft., depending upon flood conditions.

It is planned to install only six of the ten units at the present time. Three of the units that are being placed are being built by the Dominion Engineering Works and the other three by the Canadian Allis-Chalmers, Ltd. The Dominion Bridge Company will supply the structural steel, and headgates, sluice gates, cranes, etc., while the electrical machinery will be supplied by the Canadian General Electric Company. The Power Corporation of Canada is in charge of the engineering design and is exercising supervision of the work.

Last Minute News

The American Committee of the World Engineering Congress, Tokio, 1929, entertained at dinner on Dec. 6, in New York City, Dr. Masawo Kamo, of Japan. Dr. Kamo is professor of mechanical engineering at Tokio Imperial University, chairman of the Organizing Committee of the World Engineering Congress, and chairman of the Tokyo Sectional Meeting of the World Power Conference, to be held simultaneously with the Congress. Dr. Elmer A. Sperry, newly elected head of the A.S.M.E., presided at the dinner.

Thomas E. Murray Resigns N. Y. Edison Post

Thomas E. Murray, vice-chairman of the board of directors of the New York Edison Company, has tendered his resignation. Mr. Murray was senior vice-president of the company until the recent merger of the Brooklyn Edison Company and the New York Edison Compnay. He had expressed a desire for some time to be relieved of his duties as soon as the merger became effective, in order to be free to work out his ideas for improvements in steam generation and electrical distribution.

Thomas E. Murray

Mr. Murray ranks among the foremost men in the electrical industry. He has been intimately associated with the development of utilities in the Metropolitan district and, in addition, has contributed greatly to engineering progress through design and invention. His foresight and vision are attested by 350 patents and his versatility by the fact that in 1910 he advocated household electric refrigeration and more recently developed the water-walled boiler furnace. He is an officer in the Manhattan Refrigerating Company, the Electrical Testing Laboratories, the Metropolitan Engineering Company and Thomas E. Murray, Inc. He planned many of the generating stations in the New York area, contributed greatly to the improvement of boilers and accessories and developed a system of safety devices and protective appliances for interior wiring.

Largest American Liner on Maiden Trip

The International Mercantile Marine liner "Virginia," largest American built commercial vessel, left New York last week on her maiden voyage to California. The "Virginia" as mentioned in these pages some time ago, is the second of three turbine-electric liners of approximately 22,000 tons displacement, built and building at the yards of the Newport News Shipbuilding Company. Her sister ship, the "California," was launched late in 1927.

The "Virginia" is twin-screw driven by a pair of synchronous induction motors of 8,500 hp. each. Two 6,600-kw. General Electric turbine-generators supply current for the motors. Eight oil-fired Babcock & Wilcox water-tube boilers furnish steam at 300 lb. gage and 200 deg. superheat. The "Virginia" has shown a maximum speed of 18.95 knots on her full-power trials, and is expected to make the run between New York and the west coast in thirteen days.

Large British Cooling Tower Nearing Completion

The first of two reinforced-concrete cooling towers which are to serve the new electric generating station at Hams Hall, Birmingham, England, is now approaching completion. With a diameter of 168 ft. at the base, this tower and its companion are being built to a height of 220 ft. above the ground level. Beneath them are huge containers, also of reinforced-concrete construction, with a capacity of 1,736,000 gal. of water. An annular trough of reinforced concrete gives entry to the towers, each of which is planned to cool 2,666,000 gal. of water per hour.

Virginia Project Under Way

Plans announced recently by the Hydro-Electric Corporation of Virginia contemplate the building of a 10,000-hp. plant on the James River near Snowden, Va. The project is to be started immediately and is expected to be ready for service by Sept. 1, 1929.

Electricity in Bulgaria

There has been a gradual advance in electric power development in Bulgaria in the last several years, as shown in a report of the Ministry of Agriculture. There were at the close of 1927, thirty hydro-electric stations and 100 steam stations in operation in the country. Of the hydro stations, eleven have a capacity up to 100 hp., eleven from 100 to 500 hp., four from 500 to 1,000 hp., two from 1,000 to 2,000 hp., and two above 2,000 hp., one of 3,720 hp. and the other of 7,800 hp. Of the 100 steam stations at the end of 1927, of which the principal are situated in the district of Plozziz and Bourgag, sixty have a capacity up to 100 hp., twenty-nine from 100 to 500, five from 500 to 1,000 hp., four from 1,000 to 2,000 hp., and two above 2,000 hp.

The total energy figured for the year 1927 was: Hydro-electric stations, 25,634,994 kw.-hr., and steam stations, 11,097,540 kw.-hr.

Coming Conventions

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, at Washington, May, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Oil Burner Association, annual convention, Hotel Pennsylvania, New York City, April 9-11, 1929. For information, address the headquarters of the Association at 420 Madison Ave., New York City.

American Society of Heating and Ventilating Engineers, 35th annual meeting, Chicago, Ill., Jan. 28-31, 1929. A. V. Hutchinson, secretary, 29 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Engineering Institute of Canada, annual general and professional meeting, at Hamilton, Ont., Feb. 13-15, 1929. R. J. Durley, secretary, 2050 Mansfield St., Montreal, Que.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

Portland, Ore., Utility in Expansion Program

Plans for a considerable increase in the capacity of both steam and hydro-electric stations owned by the Northwestern Electric Company, of Portland, Ore., were recently announced by G. W. Talbot, president of the company. An increase of 20,000 kw. will be made to the Lincoln Street steam plant in the city, and a project is disclosed for a new hydraulic plant to be built on the Lewis River in Lewis County, Washington. This plant will provide 40,000 kw.

Ohio Mechanics Institute Holds Centennial

On Nov. 23 the Ohio Mechanics Institute at Cincinnati held its centennial celebration. Dr. John T. Faig, president of the institute, and Dean Dexter S. Kimball, of Cornell University, made the principal speeches of the occasion.

Power Commission Urges Increased U. S. Jurisdiction

New legislation to give the Federal Government wider authority in interstate power projects was proposed to Congress in the annual report of the Federal Power Commission presented Dec. 3.

Present laws, said the commission, are inadequate to permit the Federal Government to intervene in cases where the states have no authority to regulate rates and services of power corporations. The commission's own authority over the sale of interstate power, the report continues, is limited by statute to the supervision of concerns which have obtained their license from the commission itself.

Seven states have no state utility commissions, while five others have only a limited jurisdiction over power corporations. Only one-half of the states have given their utility commissions authority to regulate the security issues of such corporations.

The way to end this "twilight zone" in regulation, the commission suggests, is for Congress to confer upon the states jurisdiction to act jointly where two or more states are involved and to confer upon a Federal agency jurisdiction to review the findings of state bodies.

Dam Enlarged

Four feet is being added to the crest of the hydro-electric dam of the Page Power Company at Luray, Va. The new addition to the dam, which impounds the waters of the Shenandoah River, will raise the capacity of the present plant from 1,400 hp. to 1,875 hp., a 30 per cent increase. The William C. Whitner Company of Richmond has the contract.

OBITUARY

SAMUEL G. RHODES, general superintendent of the Distribution and Installation Department of the New York Edison Company, widely known as an authority on technical subjects, died suddenly Nov. 22, at his home in Brooklyn, N. Y.

Mr. Rhodes was assistant to the vice-president of the Yonkers Electric Light & Power Company and was consulting engineer for the United Electric Light & Power Company, New York & Queens Electric Light & Power Company, Westchester Lighting Company and the Bronx Gas & Electric Company. Born in New York City in 1872, and educated at Cooper Union, his first employment was with the New York Edison Company as a wireman in 1889. He worked his way up through the grades of foreman, general foreman and others until he reached the positions held at the time of his death. He was appointed assistant to the vice-president and general manager in 1920 and was

made general superintendent of the Distribution and Installation Department in 1921.

Mr. Rhodes was a fellow of the American Institute of Electrical Engineers, and of the Illuminating Engineering Society; a past vice-president, director and member of the New York Electrical Society; a past-secretary, director and member American Engineering Standards Committee, and a member and official of many other technical organizations.

STRICKLAND L. KNEASS, engineer and inventor, died Nov. 24, at his home near Philadelphia, Pa., following a short illness. A graduate of Rensselaer Polytechnic Institute, Mr. Kneass became widely known for his inventions of devices used in steam engineering and as an authority on thermodynamics. His scientific achievements were recognized by many engineering societies, including the Franklin Institute, which association awarded him the John Scott medal in 1904. He was a contributor of articles on thermodynamics, non-ferrous metals and similar subjects to technical journals, was a trustee of Rensselaer Institute, and a member of the National Institute of Social Science, the American Society of Mechanical Engineers, the Franklin Institute and other societies.

WALTER J. KLINE, construction engineer of the American District Steam Company, of North Tonawanda, N. Y., died suddenly on Nov. 17. At the time of his death, he was a director in the American District Steam Company, and the vice-president of the Northeastern Piping & Construction Company, a subsidiary.

PERSONALS

H. SCHRECK, well-known Diesel engine designer, is now connected with the Ingersoll-Rand Company, at the Rathburne-Jones, Toledo, Ohio, plant.

CHARLES A. STONE and EDWIN R. WEBSTER, heads of the firm that bears their names, were honored at a dinner given in Richmond, Va., on Dec. 1, in recognition of the winning of the Charles A. Coffin transportation medal, awarded recently to the Virginia Electric & Power Company, a Stone & Webster subsidiary.

PROF. FREDERICK E. TURNEAURE, of the University of Wisconsin, will be honored on Dec. 11 by a banquet commemorating the 25th anniversary of his incumbency in the office of dean of the College of Engineering of the University. Prof. E. R. Maurer, head of the department of mechanics, will preside at the dinner, and Prof. D. W. Mead, head of the department of hydraulic engineering, will be the principal speaker.

FRANCIS M. DAWSON, for the last six years professor of hydraulics at the University of Kansas, has resigned to accept a professorship of hydraulics at the University of Wisconsin.

With the Society Sections

American Engineering Council, annual meeting, to be held in Washington, D. C., Jan. 14-15, 1929, at the Mayflower Hotel.

A. S. M. E., Syracuse Section. Meeting Dec. 17, at the Onandaga Hotel. Subject: Lubrication, by R. P. Tobin, chief engineer of the Vacuum Oil Company.

A. S. M. E., Hartford Section. Meeting at the Hartford Electric Light Company's auditorium Dec. 18. Subject: Opportunities for Public Service Usefulness, by Samuel Ferguson, president, Hartford Electric Light Company.

A. S. H. & V. E., Philadelphia Chapter. Meeting Dec. 13. Subjects: "Surveys of Aeration and Typical Industrial Building," by W. C. Randall, chief engineer, Detroit Steel Products Co., and "Some Laws of Natural Ventilation and their Application," by Prof. J. E. Emswiler, Univ. of Michigan.

American Water Works Association, New York Section. Meeting, Dec. 28, at the Hotel Pennsylvania. This will be a luncheon meeting.

American Water Works Association, Kentucky-Tennessee Section. Annual meeting, to be held at Chattanooga, Tenn., Jan. 24-26, 1929.

National Marine Engineers Benefit Association. The 54th annual meeting will be held in Washington, D. C., Feb. 11-16, at the Hotel Hamilton.

Engineers' Club of St. Louis. Meeting Feb. 13, 1929. Subject: "Steam Storage and Steam Distribution," by R. A. Longworthy, vice-president and general manager of Ruths Accumulator Company.

Providence Engineering Society, Power Section. Meeting, Dec. 13. Subject: "Out of the Darkness" (Scientific treatment of water to prevent scale and corrosion), by Dr. R. E. Hall.

BUSINESS NOTES

THE WAGNER ELECTRIC CORPORATION, of St. Louis, Mo., announces that F. T. Coup, in charge of the Cincinnati office since 1921, has been moved to the Milwaukee office as branch manager there. The company also announces that H. N. Felton, branch manager of the Milwaukee office since 1927, has been made branch manager of the New York office.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., announces that it has recently moved its Atlanta, Ga., office into new quarters at 150 Peters St., that city. A. C. Gibson is manager in charge of the Atlanta office.

TRADE CATALOGS

CONDENSERS—Bulletin 5-AA, recently issued by the Schutte & Koerting Company, Philadelphia, Pa., covers the subject of multi-jet condensers. The bulletin contains twelve pages and has several illustrations, charts and diagrams.

AUTOMATIC PUMPING—Bulletin No. 850, issued by Barrett, Haentjens & Company, Hazleton, Pa., is an eight-page publication dealing with suction-lift centrifugal pumps arranged for automatic operation. Explanatory diagrams and text, together with several photographs, give a clear idea of the operation of the equipment.

BOILERS—The Erie City Iron Works, Erie, Pa., has recently issued a sixteen-page bulletin entitled "Return Tubular Boilers." Many photographs of complete units, cut-aways and charts serve to illustrate the construction and application of these boilers.

REGULATORS—In catalog No. 50 the Locke Regulator Company, Salem, Mass., presents a complete picture of its product for regulating the flow of steam and other fluids. Descriptions of each type of regulator, together with illustrations, dimensional data and diagrams, make the catalog unusually complete.

REGULATING VALVES—A four-page leaflet has just been issued by the Northern Equipment Company, Erie, Pa., illustrating its Type SS differential water-pressure regulating valve. A general description of the valve is given, together with a cross-sectional drawing and operating pressure charts.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.25@$2.50
Kanawha	Columbus	1.65@ 1.75
Smokeless	Cincinnati	2.25
Smokeless	Chicago	1.65@ 2.25
S. E. Kentucky	Chicago	1.35@ 1.75
Steam	Pittsburgh	1.75@ 1.90
Gas Slack	Pittsburgh	.90@ 1.00
Big Seam	Birmingham	1.25@ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.00
Barley	New York	1.75@ 2.00

FUEL OIL

New York—Dec. 6, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4¾c. per gal.; 36@40 deg., furnace, tank-car lots, 6½c. per gal.

St. Louis—Nov. 28, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.40 per bbl. or 42 gal.; 26@28 deg., $1.45 per bbl.; 28@30 deg., $1.50 per bbl; 30@32 deg., $1.55 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 5.375c. per gal.

Pittsburgh—Nov. 19, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—Dec. 1, 13@19 deg., $0.95@$1.02 per bbl. or 42 gal.; 22 deg. plus, $1.47@$1.53 per bbl.; 26@30 deg., $2.00@$2.06 per bbl.

Cincinnati—Dec. 4, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Nov. 17, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., 97½c.@$1 per bbl.

Boston—Dec. 3, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.56c. per gal.; 28@32 deg., 5.6c. per gal.

Dallas—Dec. 1, f.o.b. local refinery, 26@30 deg., $1.20 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ark., Little Rock—Arkansas Cold Storage Co., C. E. Rose, Mgr., will soon receive bids for the construction of a cold storage plant at foot of Rock St. Estimated cost $200,000.

Calif., Westwood — William Fox Film Corp., awarded contract for the construction of a group of studio buildings to George Miller, 101 North Pruess Rd. Estimated cost $10,000,000. Steam heating and refrigeration systems, etc., will be installed.

Colo., Denver—Jones Bros., c/o B. M. Jones, 2325 West St., Pueblo, Engr., plans the construction of a hydro-electric plant, 30,000 kw. capacity in North St. Vrain canyon between Copeland Park and Lyons. Estimated cost $5,000,000.

Conn., New Haven—Koppers Co., Waterfront St., awarded contract for the construction of a pump house on Alabam Ave., to Koppers Construction Co., Alabama Ave. Estimated cost $60,000.

Conn., New Haven—New Haven Pulp & Board Co., 265 East St., awarded contract for a 31 x 65 ft. addition to boiler plant to H. Wales Lines Co., 134 State St., Meriden. Estimated cost $45,000.

Ill., Champaign—State of Illinois Athletic Association, G. Huff, Dir., New Gymnasium Bldg., will soon receive bids for the construction of an ice skating rink at 5th and Armory Sts. Estimated cost $200,000. Halabird & Root, 333 North Michigan Ave., Chicago, Ill., are architects.

Ia., Marengo—City, F. W. Goldthwaite, Clk., is having preliminary plans prepared for the construction of an electric light plant including three generating units, storage tanks, etc. Estimated cost $157,000. Municipal Utilities Co., 421 Hubbell Bldg., Des Moines, is engineer.

Kan., Randall — City will soon award contract for waterworks improvements including pump house, tank on tower, etc. Estimated cost $21,000. Shockley Engineering Co., 800 Graphic Arts Bldg., Kansas City, Mo., is engineer.

Kan., Wichita — Missouri Pacific R.R. Co., Missouri Pacific Bldg., St. Louis, awarded contract for a 38 x 40 ft. power house to Blaser-Bollmer Construction Co., Wichita, Kan. E. A. Hadley is chief engineer.

Mass., Brockton—Brockton Edison Electric Co., A. F. Nelson, Mgr., Main St., awarded contract for the construction of a sub-station to Powers Bros., 161 Montello St. Estimated cost $75,000.

Mass., Brockton—Brockton Ice & Coal Co., 426 Main St., will build an ice plant on Lawrence St. Estimated cost $75,000. Funk & Wilcox, 26 Pemberton Sq., Boston, are engineers. Work will be done by separate contracts. Former contract rescinded.

Mass., Charlestown (Boston P.O.)—J. Staffieri, 358 Medford St., awarded contract for the construction of a boiler house, also repair and service garage to F. Santini, 15 Bowdoin St., Arlington. Estimated cost $45,000.

Mass., Pittsfield—Berkshire Sanitary Ice Co., J. Everwein, 159 Seymour St., awarded contract for the construction of an artificial ice plant on Curtis St., to W. L. Goetz, 16 Kenwood St. Estimated cost $50,000.

Mass., South Boston (Boston P. O.) — Andrew Sq. Terminal Co., Inc., 53 State St., Boston, is having preliminary plans prepared for the construction of a 3 story, 200 x 300 ft. garage and industrial building, including power house, coal handling machinery, etc., at Dorchester Ave. and Dexter Sts., here. Estimated cost $3,000,000. R. A. Stowell, 184 Boylston St., Boston, is architect. H. S. Cleverdon, 46 Cornhill, Boston, is engineer.

Mass., Woburn—N. Anderson, 71 Middle St., will build three 80 x 500 ft. greenhouses, also boiler house on Middle St. Private plans. Work will be done by separate contracts.

Mich., Clio — City, R. Covert, Clk., is having plans prepared for improvements to waterworks and sewage systems, including sewage treatment plant and pumping station. Hoad, Decker, Shoecraft & Drury, Ann Arbor, are engineers.

Mo., Kansas City — United States Cold Storage Co., 500 East Third St., awarded contract for the construction of a cold storage plant at 500 East Third St., to E. W. Sproul, 310 South Michigan Blvd., Chicago, Ill. Estimated cost to exceed $150,000.

Neb., Edison—City plans an election Dec. 17 for waterworks improvements including wells, pump house, mains, etc. Estimated cost $18,000. Henningson Engineering Co., Union State Bank Bldg., Omaha, is engineer.

O., Apple Creek—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., will receive bids until Dec. 27 for the construction of a 79 x 109 ft. power house at Institution site. Estimated cost $57,900. H. B. Briggs, Ohio-Hartman Bldg., is engineer.

O., Cincinnati—Union Gas & Electric Co., W. W. Freeman, Pres., 4th and Plum Sts., plans the construction of a central heating plant. Estimated cost $2,000,000. Columbia Engineering & Management Corp., 61 Broadway, New York, is engineer.

O., Hilltop (br. Columbus)—City Ice & Fuel Co., E. C. Balzhizer, V. Pres., 6611 Euclid Ave., Cleveland, is having plans prepared for a 1 story ice plant here. Estimated cost $75,000. W. A. Schmid, 3229 Jefferson Ave., Cincinnati, is engineer.

O., Wilberforce—Bd. of Trustees, Wilberforce University, J. O. Haithcox, Secy., will recive bids until Dec. 27 for the construction of a 47 x 85 ft. power house. Estimated cost $150,000. H. B. Briggs, Ohio-Hartman Bldg., Columbus, is engineer.

Okla., Marshall—Taylor-Easterling Co., Kennedy Bldg., Tulsa, plans the construction of a 10 ton raw water ice plant, here. Estimated cost $25,000. Private plans.

Okla., Maud—Traders Finance Corp., Braniff Bldg., Oklahoma City, is having plans prepared for the construction of a 20 ton ice plant here. Estimated cost $30,000. Private plans.

Okla., Yale—Yale Utility Co. plans the construction of a 25 ton raw water ice plant. Estimated cost $40,000. Private plans.

R. I., Pawtucket—Pawtucket Ice Co., H. L. Russell, 126 Main St., is having preliminary plans prepared for the construction of an artificial ice plant. Estimated cost $40,000 to $50,000. Monahan & Meikle, 255 Main St., are engineers.

Tex., Midland — City is having preliminary surveys made for waterworks improvements including pumping equipment, etc. Estimated cost $70,000. B. F. Haag, Mayor.

Ont., Niagara Falls—Water Commission, A. Collins, 981 Jepson St., Chn., plans election soon to vote $450,000 bonds for waterworks improvements, including pump house and filtration plant, etc. F. A. Dallyn, 71 King St. W., Toronto, is engineer.

Equipment Wanted

Boiler — U. S. Engineer Office, Kansas City, Mo., will receive bids until Dec. 17 for a water tube boiler two cross drum type marine boiler.

Generator, Etc. — U. S. Engineer Office, Nashville, Tenn., will receive bids until Dec. 18 for an electric generator, switchboard, refrigerator and refrigerator cooling system, etc.

Pump, Engine, etc.—City Counsel, J. B. Jones, Mayor, will receive bids until Dec. 18 for one 200 g.p.m. centrifugal pump against 120 ft. head, belt driven by 25 hp. engine for proposed waterworks improvements.

Pumps — City of Gould, Okla., A. R. Reeves, Clk., will receive bids until Dec. 20 for two triplex pumps, etc., for proposed waterworks improvements. Estimated cost $59,000.

Pumps—City plans to purchase electrically operated centrifugal pumps, etc., for proposed sewage treatment works.

Pumps, Motors, etc. — Hinde & Dauche Paper Co., 45 Hanna St., Toronto, Ont., is in the market for pumps, electric motors and other equipment for proposed paperboard plant. Estimated cost $300,000.

Industrial Projects

Conn., Fairfield — CHEMICAL MANUFACTURING PLANT—McKesson & Robbins Co., Grasmere St., awarded contract for a 5 story, 100 x 200 ft. plant, to E. & F. Construction Co., 94 Wells St., Bridgeport. Estimated cost $155,000.

Conn., New Britain — ENAMELING BUILDING—Landers, Frary & Clark, Center and Commercial Sts., awarded contract for a 1 story, 123 x 200 ft. enameling building, and 30 x 123 ft. storage building, to Morton C. Tuttle Co., 862 Park Sq. Bldg., Boston, Mass. Estimated cost $110,000.

Fla., Miami—TIRE and RUBBER FACTORY — Firestone Tire & Rubber Co., South Main St., Akron, O., c/o W. C. Harris, Jacksonville, Fla., is having plans prepared for the construction of a factory at West Flagler St. and 12th Ave. here. Estimated cost, $250,000.

Ind., Crawfordsville—STEEL FACTORY —Mid-States Steel Co. awarded contract for a 1 story, 85 x 250 ft. factory. Estimated cost $50,000.

Ind., Indianapolis—ROAD MACHINERY FACTORY——J. D. Adams, 217 South Belmont St., awarded contract for a 1 story, 108 x 175 ft. factory for the manufacture of road machinery, to Hall Construction Co., 406 Bd. of Trade Bldg. Estimated cost $45,000.

Mass., Groton—LEATHERBOARD UNIT —Groton Leatherboard Co. awarded contract for a 2 story, 60 x 200 ft. unit to plant, to Fiske-Carter Construction Co., 11 Foster St., Worcester. Estimated cost $150,000.

Mich., Detroit — MACHINE SHOP — Chrysler Corp., 341 Massachusetts Ave., Highland Park, awarded contract for a 1 story, 160 x 180 ft. machine shop on East Jefferson Ave., here, to H. G. Christman-Burke Co., 315 Stevens Bldg., Detroit. Steam heating, electric motors, etc., will be installed.

Mich., Detroit—BEARINGS FACTORY—Federal Mogul Corp., 11031 Shoemaker Ave., is having plans prepared for a 1 story, 120 x 180 ft. factory. Estimated cost $50,000. Pollmar & Ropes, 704 Huffman Bldg., are architects. Owner is in the market for machine equipment for making bearings for automobiles, also electric motors.

Mich., Detroit — AUTOMOBILE BODY PLANT—Murray Corp. of America, 1424 Aberle St., is having plans prepared for a 1 and 6 story, 250 x 425 and 350 x 525 ft. plant at Russel and Colby Sts. A. Kahn, 1000 Marquette Bldg., is architect. Owner is in the market for steam heating, electric motors and press shop equipment.

Mich., Grand Rapids—MACHINE SHOP —Hayes Body Corp., Seventh and Muskegon Aves., awarded contract for a 1 story, 120 x 205 ft. machine shop, to Austin Co., 11-243 General Motors Bldg., Detroit. Estimated cost $60,000. Steam heating, electric motors and miscellaneous machine shop equipment will be installed.

Mo., Crystal City—GLASS PLANT ADDITION—Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., will build a 2 story, 100 x 1,000 ft. addition to glass plant, here. Estimated cost $750,000. Work will be done by separate contracts.

Tex., San Angelo—CREAMERY—Snowhite Creamery Co., 127-29 North Chadbourne, is having plans prepared for the construction of a 1 and 2 story, 140 x 160 ft. creamery at Second and Gillis Sts. Estimated cost $100,000. R. K. Hamberlin, 807 Builders Exchange Bldg., San Antonio, and H. I. Messick, 212 Ricker and Dodson Bldg., San Angelo, are architects.

B. C., Port Mellon — PULP and LUMBER MILL — Vancouver Kraft Co. Ltd., Oregonian Bldg., Portland, Ore., awarded contract for reconditioning and extending pulp and lumber mill here, to Vancouver Pile Driving & Contracting Co., 207 Hastings St. W., Vancouver, B. C. Estimated cost $2,000,000.